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ABSTRACT

In February 2000, the Benton Foundation, with the Center for Children and Technology, released "The E-Rate in America: A Tale of Four Cities." This report is a continuation of that work. Two overarching concerns have emerged in the current policy climate: it is imperative that the E-Rate program is structured in such a way as to maximize impact and it is critical to be able to measure a return on the nation's massive educational technology investment. Findings and observations are compiled in this report, with chapters written by experts in the field of educational technology. The first chapter, "E-Rate 102," by Norris Dickard, recounts some of the E-Rate program's growing pains and new policy challenges facing it. In the second chapter, "The E-Rate Takes Hold, but Slowly," Donna Harrington-Lueker reports on lessons that emerged from interviews with administrators, teachers, and technology researchers in the same four cities studied in "The E-Rate in American" (Chicago, Cleveland, Detroit and Milwaukee). In the third chapter, "New Approaches to Assessing Students' Technology-Based Work," Margaret Honey addresses the timely issue of measuring return on investment in a policy climate focused on accountability. The fourth chapter, "Assessment of Students' Technology-Based Work: An Overview of the Toolkit and Case Studies" by Andy Gersick, Constance Kim, Julie Thompson Keane, Wendy Friedman, and Katie Culp, presents case studies in which researchers worked in individual classrooms with teachers in the cities of Chicago and Milwaukee. Together, they developed assessment tools and guidelines to help teachers measure learning gains as students learned to use various information technology tools for research and presentation-compiled into an "evaluation toolkit" (available online and as a supplementary publication to this report). In the last chapter, "Enhancing State and Local Policymaking about Educational Technologies," Chris Dede introduces his "state policy framework" and outlines the need for a more coordinated and systematic approach to policymaking around educational technology. Appendixes present the "State Policy Framework" and outline educational technology evaluation resources. (AEF)

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The E-Rate at Five, Enhancing Policymaking and New Evaluation Models

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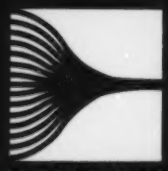

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GREAT EXPECTATIONS
LEVERAGING AMERICA'S INVESTMENT IN EDUCATIONAL TECHNOLOGY

Benton Foundation
Communications Policy Program

Education Development Center, Inc.
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Edited by Norris Dickard

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PREFACE: DIGITAL OPPORTUNITY FOR ALL STUDENTS

When Congress created the E-Rate by enacting the historic Telecommunications Act of 1996, a bipartisan coalition of members understood that universal service needed to be expanded to meet new challenges. Universal service was traditionally associated with equal access to telephone service, but the advent of personal computers and the Internet resulted in powerful new tools for communication – and new disparities to address.

In the mid-1990s, our growing recognition of the promise that new telecommunications tools held for education, economic development, civic discourse and career advancement came at a time of growing concern over a "digital divide" separating individuals and communities that had access to these tools from those that did not.

The Telecommunications Act of 1996 was first and foremost an effort by Congress to spur the development of affordable and widespread telecommunications services by deregulation and increased industry competition. It was also acknowledged that more needed to be done to ensure that underserved communities, especially in rural areas and poor communities, were not at a competitive disadvantage when new information networks were created or expanded. Thus, the E-Rate, and its discounts on telecommunications services to schools and libraries serving disadvantaged individuals, resulted from a bipartisan commitment to provide equal educational opportunity and access to information technology tools for all Americans.

Information released by the U.S. Census Bureau in August 2000 demonstrates that focusing needed resources on schools and libraries in disadvantaged urban and rural communities has made a significant difference. Ninety-four percent of school-age children in homes with an income above $75,000 have computer access at home, although only 35 percent of school-age children in households with income under $25,000 have home computer access. Schools have filled the gap for these low-income children, where 72 percent had access.

As the following report shows, great progress has been made in bridging the digital divide, and the E-Rate has been a critical source of building materials for this bridge. But, this is no time to rest on our laurels. To support the unique opportunities technology offers to improve teaching and learning, work remains to be done in a number of areas, including professional development, curriculum design and assessment. This timely report highlights a number of areas where work is needed and provides useful tools and suggestions for maximizing this important investment.

Representative Edward J. Markey (D-Mass.)

Senator John D. Rockefeller (D-W.Va.)

Senator Olympia J. Snowe (R-Maine)

Representative Fred Upton (R-Mich.)

INTRODUCTION THE E-RATE AT FIVE

Over the past 10 years the nation has invested $37.9 billion to bring educational technology (ed tech) and Internet connectivity to America's schools. Like their counterparts in the private sector, educators, administrators and policymakers are hoping that by harnessing technology, they can vastly improve the productivity of the educational enterprise.

The E-Rate's telecommunications discounts recently made available to schools combined with other federal, state and local funding has been the catalyst for tremendous progress (see Chart 1). Recent data indicate that:

- By the fall of 2000, 98 percent of public schools in the U.S. had access to the Internet, compared to 35 percent in 1994.
- In 1994 only 3 percent of instructional classrooms had computers with Internet access; 77 percent were connected by fall 2000. As in previous years, there were still signs of a digital divide. Schools with the highest concentration of students in poverty were much less likely to have connected computers in the classroom (60 percent connected) than those with lower concentrations of poverty (80 percent connected). While more needs to be done in this area, the data suggest that the rapid closing of the gap was due in part to the E-Rate.
- By fall 2000, the ratio of students to instructional computers had decreased to 5 to 1, a ratio considered by some experts to be "a reasonable level for the effective use of computers within the schools." However, the ratio was greater (9 to 1) in schools with the highest concentration of students in poverty.

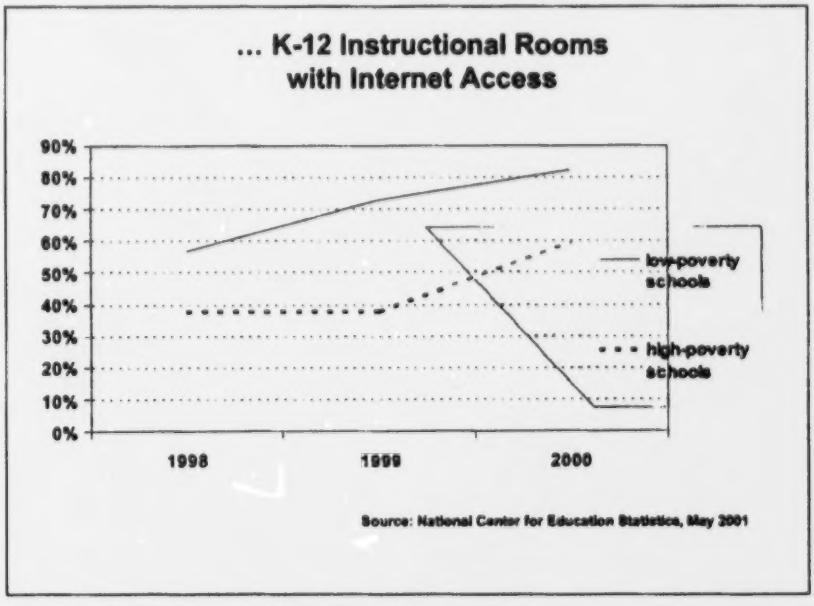

Chart 1: K-12 Instructional Rooms with Internet Access

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Over the years, changes have also occurred in the type of network connections used by schools and the speed at which they are connected to the Internet. Since the E-Rate cannot be used for computer, software or support services, its investment is expected to have the greatest impact in the area of connectivity. Progress appears to have been made in this area as well:

- In 1996, dial-up connections were used by almost 74 percent of public schools with Internet access. By 2000, schools tended to also use faster, dedicated lines such as T1/DS1 or fractionalized T3 lines.
- In 2000, 77 percent of schools used dedicated lines to connect to the Internet while only 11 percent used dial-up connections; 24 percent used other continuous-type connections such as ISDN or cable modems.

In February 2000, the Benton Foundation, collaborating with the Center for Children and Technology (CCT), released *The E-Rate in America: A Tale of Four Cities*. This report, made possible also through the generous support of the Joyce Foundation, is a continuation of that joint work.

The E-Rate in America was one of the first studies of the impact of the then-new federal program, tracing the ideas and political battles that led to its establishment and recounting the practical issues confronting school districts as they sought to benefit from E-Rate resources. Also included in that work were questionnaires designed to help school officials begin the process of assessing technology use in their schools.

As part of *The E-Rate in America*, four large urban districts (Chicago, Cleveland, Detroit and Milwaukee) were studied in fall 1999. While each of the districts had a unique experience when it came to planning, applying for and using E-Rate discounts, the process afforded a number of common benefits to all of them:

- E-Rate discounts made it possible for the districts to accelerate their network infrastructure development and dramatically expand Internet access.
- The E-Rate freed up resources to pay for other elements of district educational technology programs such as computer and software purchases and teacher professional development.
- The E-Rate application process led to improved district planning practices.

At the same time, E-Rate implementation raised new challenges and taxed districts' resources in the following manner:

- The E-Rate process strained relationships with vendors who provided the telecommunications services to schools.
- It was necessary for administrators and community stakeholders to be made more aware of the impact of the program.
- Much-needed building basics not covered by the E-Rate, such as electrical upgrades and hardware purchases, delayed the deployment of information technology.
- Teacher professional development needs increased dramatically.
- Districts were becoming highly dependent on E-Rate funding to sustain their networks.

In this second phase of our E-Rate work, the Benton Foundation and the Center for Children and Technology continued our investigation into the new program and developed new tools to assist teachers, administrators and policymakers. In early November 2001, E-Rate funding commitments were still being made for year four of

the program and the year five application window opened. Two overarching concerns have emerged in the current policy climate: It is imperative that the E-Rate program is structured in such a way as to maximize impact and it is critical to be able to measure a return on the nation's massive educational technology investment. The Benton Foundation and CCT have compiled our findings and observations into this new report, ***Great Expectations, Leveraging America's Investments in Educational Technology***, with different chapters written by experts in the field of educational technology.

The first chapter, "E-Rate 102," by Norris Dickard, recounts some of the E-Rate program's growing pains and new policy challenges facing it. Drawing on a dialogue that took place at two national policy roundtable events in May 2001, and through interviews with key policymakers, Dickard suggests future improvements to program structure and administration. The chapter will be of general interest to those interested in telecommunications policy and of special interest to those policymakers contemplating program improvements.

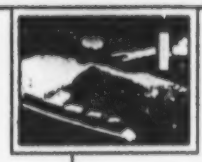
In the second chapter, "The E-Rate Takes Hold, But Slowly," Donna Harrington-Lueker, of the Education Writers Association (EWA), reports on lessons that emerged from interviews with administrators, teachers and technology researchers in the same four cities studied in ***The E-Rate in America***. This chapter, reprinted with permission from EWA, was part of a larger report on technology in urban schools – also commissioned by the Joyce Foundation. It provides an update on the progress in Chicago, Cleveland, Detroit and Milwaukee since the publication of ***The E-Rate in America*** and makes the case that building computer networks may be easier than helping schools use the technology to its maximum potential.

The third and fourth chapters, by Margaret Honey and her colleagues at the Center for Children and Technology, address the timely issue of measuring return on investment in a policy climate focused on accountability. She writes that we must move beyond seeking a direct correlation between technology investments and rising standardized test scores. Rather, Honey argues, it is important to create assessment frameworks that directly correspond to the unique teaching and learning opportunities that technologies make possible.

The fourth chapter presents case studies in which CCT researchers worked in individual classrooms with teachers in the cities of Chicago and Milwaukee. Together, they developed assessment tools and guidelines to help teachers measure learning gains as students learned to use various information technology tools for research and presentation – compiled into an "evaluation toolkit," available online and as a supplementary publication to this report. This toolkit will be of particular use to classroom teachers and researchers thinking about evaluation. The evaluation toolkit is available online at www.benton.org/e-rate/execsummary.html.

In the last chapter, Harvard University's Chris Dede introduces his "state policy framework" and outlines the need for a more coordinated and systematic approach to policymaking around educational technology. He explains how educational technology investments impact, and are impacted by, the larger educational reform context in which they are made. With greater decision-making being driven down to state departments of education through block grants and other consolidation of federal funding, the matrix will be a useful tool for both state and local administrators.

CHAPTER 1:
E-RATE 102: POLITICS, POLICY AND PROGRESS



BY NORRIS DICKARD

As a result of the E-Rate and other federal educational technology investments, great progress has been made in bringing multimedia computers, high-speed networks and Internet connections to America's schools and libraries.

The Benton Foundation and CCT's report, *The E-Rate in America: A Tale of Four Cities*, explained how the E-Rate program worked, and in a chapter appropriately titled "E-Rate 101," reported on the passage of the legislation authorizing the E-Rate and described the initial start-up phase of the program. This chapter updates that information by describing progress to date and programmatic growing pains and suggesting areas of possible improvement. This chapter, like others in this report, benefited from a dialogue among federal, state, local, foundation and corporate stakeholders who participated in two Benton E-Rate/ed tech roundtables, held in May 2001 in Chicago and Milwaukee.

RECAP: FROM SNOWE-ROCKEFELLER TO FCC PROGRAM

From the beginning, the creation of the E-Rate was by no means assured. The Markey-Fields bill, calling for an "E-Rate," or education rate, passed the House by a vote of 423-4 in June 1994 but died when the Senate did not take their bill to the floor in the waning days of the 103rd Congress. As part of the 1995 deliberations over the reauthorization of the Communications Act of 1934, the bipartisan Snowe-Rockefeller Amendment, calling for the creation of the E-Rate, barely made it out of the Senate Commerce Committee – winning approval by only one vote. Late in the legislative process, one member of Congress described the entire telecom bill as "dead as Elvis." The amendment, however, soon became a rallying cry for the schools and libraries community who argued that such funding was needed to bridge a digital divide that existed in their institutions. The House and Senate ultimately passed a compromise bill that was signed into law, with the E-Rate included.

The Telecommunications Act of 1996 expanded the traditional definition of universal service – nationwide phone service at a reasonable cost to consumers – to include broader telecommunications assistance to schools and libraries. The act authorized the Federal Communications Commission (FCC) to create a program offering discounts to these institutions on eligible telecommunications services (such as phone service, Internet access, internal connections and related equipment). The E-Rate provides discounts ranging from 20 to 90 percent to applicants in urban and rural areas. Larger discounts go to those deemed economically disadvantaged based on their service to students eligible to participate in the federal school lunch program. Local and long-distance telephone companies contribute funding. In the first two years of the program, the E-Rate committed nearly $4 billion in telecommunications discounts.

The Schools and Libraries Corporation (SLC) was set up to administer it, and in November 1998, mailed its first wave of commitment letters to successful applicants. On January 1, 1999, the SLC later became the SLD, the Schools and Libraries Division, of the Universal Service Administrative Company.

THE E-RATE TURNS TWO

In September 2000, shortly after the publication of the *E-Rate in America*, the U.S. Department of Education released its findings from a preliminary study on who and what was funded in the first two years of the E-Rate.

Among the key findings from this study:

- Eighty-four percent of E-Rate discounts went to the nation's public schools, despite private schools and libraries being eligible.

- E-Rate per-student funding to school districts increased dramatically with poverty, and the most disadvantaged districts received almost 10 times as much per student as the least disadvantaged.
- Urban schools and libraries, typically with greater concentrations of poor children and tending to be larger in size, received larger average funding levels and higher funding per student.
- Because program funding is strongly tied to poverty and minority concentration is highly correlated with poverty, total and average per-student E-Rate funding generally increased with higher concentrations of minority (nonwhite) students.
- In the first two years, the largest share of E-Rate funds, 58 percent, was used to support the acquisition of equipment and services for internal building connections; 34 percent was used for telecommunications services; 8 percent was allocated for Internet access costs.

E-RATE FUNDING (in billions of dollars)

Year	#Applications	$ Requested	Commitments	Amount
1	30120	$2.4	24967	$1.7
2	32000	$2.4	29871	$2.13
3	36000	$4.7	26307	$2.12
4	35300	$5.2	24509	$1.6*

* As of 10/30/01.

THE E-RATE AND THE BUSH ADMINISTRATION

With the inauguration of George W. Bush as president in January 2001, many wondered what the future would hold concerning federal education technology investments. In a positive first move, Bush tapped Rod Paige, who had served as superintendent of the Houston Independent School District, to be his education secretary. Paige was highly regarded and hailed as a "tech champ" who knew how to move districts from "old school to e-school." For example, after a report on the deplorable state of many Houston school libraries, Paige announced a plan to spend millions to bring new technology resources into school libraries and ordered the purchasing of new electronic reference materials.

When making his first domestic policy priority announcement as president, Bush issued an education manifesto titled "No Child Left Behind." The policy blueprint, calling for the revamping of the Elementary and Secondary Education Act (ESEA), proposed to consolidate existing educational technology programs, arguing that:

Schools should use technology as a tool to improve academic achievement, and that using the latest technology in the classroom should not be an end unto itself. This proposal begins to accomplish that goal by streamlining duplicative technology programs into a performance-based technology grant program that sends more money to schools. Consolidating the technology grant programs and allocating with E-Rate funds by formula ensures that schools will not have to submit multiple grant applications and incur

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the associated administrative burdens to obtain education technology funding.

President Bush proposed a fiscal year 2002 Department of Education increase that he said would be, at 11 percent with $4.6 billion in new funding, the highest for any federal agency. "Education is my top priority and, by supporting this budget, you'll make it yours as well," Bush told Congress during his State of the Union address. The details on funding for specific programs would come several months later.

The Bush administration proposal to merge the E-Rate with other Department of Education technology programs created a firestorm. Senator Jay Rockefeller (D-W.Va), one of the program's key congressional champions, immediately announced his opposition to President Bush's proposal, calling it "a grave mistake...a major step backwards." He promised to fight the consolidation, arguing:

Each school [under the E-Rate] gets to apply for the telecommunications services they want and need. Under the Bush block grant approach, local schools would have less flexibility, not more. Under the Bush block grant, private and parochial schools would have to negotiate with state education agencies and worry about entanglements of federal regulations. Most importantly, the secure funding for the E-Rate and investments in technology would be jeopardized.

Senator Rockefeller also said that consolidating the E-Rate would be breaking a "deal" that was cut as part of the 1996 Telecommunications Act, a national quid pro quo between telecom companies and the American public:

The telecommunications companies wanted more competition and the ability to expand. In exchange, we insisted on a strong, continued commitment by the telecommunications companies to "preserve and advance" universal service, including access to advanced telecommunications services for schools, rural health care providers and libraries.

The Consortium for School Networking (CoSN) and the International Society for Technology in Education (ISTE), in a joint policy statement entitled "Preparing the Classroom for the 21st Century," weighed in with the new Bush administration as well. They noted that the ESEA reauthorization would likely include the consolidation of some ed tech funding, giving more discretion to states and local communities over the use of those funds, but they admonished, "The gains that have been achieved thus far will be imperiled if the federal government simply cedes its leadership role in this area."

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In particular, CoSN and ISTE urged the new Bush Administration to:

- Maintain the emphasis on equity in federal ed tech programs
- Increase the focus on professional development
- Connect federal ed tech support to rigorous assessment
- Examine the utility of technologies as assessment tools
- Expand the federal research agenda in ed tech
- Create a national ed tech clearinghouse
- Preserve federal leadership activities
- Maintain the E-Rate program

In the context of the E-Rate, the specter of block grants as a prelude to future cuts fueled much opposition to the proposal. In their ed tech campaign proposals, the Bush domestic policy team had been careful to combine ed tech funding into one block, without proposing an overall cut. The $3 billion called for in the Bush campaign ed tech proposal was roughly the same amount as the E-Rate and ESEA Title III programs combined. But many in the education community feared that a move to fund the very large E-Rate investments ($2.25 billion) as part of the U.S. Department of Education budget and federal appropriations process would open up the program to cuts – immediate or in the future.

Indeed, with the warning volleys fired, the Bush Administration quietly backed off of their proposal to combine the E-Rate with other Department of Education funds. In testimony on ESEA reauthorization before the House Committee on Education and the Workforce on March 7, 2001, Education Secretary Paige said President Bush would not try to change the E-Rate. In an *eSchool News* article, White House spokeswoman Lindsay Kozburg confirmed Paige's statement and is reported to have added, "It's not something that's happening with this round of consolidations ... what we are pursuing right now is [the consolidation of] programs that are currently [administered by] the Department of Education ... we are certainly reviewing whether we can, and should, consolidate the E-Rate."

Critics felt their staunch opposition had been justified when President Bush's detailed fiscal year 2002 budget emerged in spring 2001. Bush called for a 6 percent reduction ($817 million, down from $872 million in the prior level of appropriations) in his proposed state block grant to replace the existing ESEA Title III educational technology programs. Defenders of his budget pointed out that $817 million was the same as the Clinton Administration's fiscal year 2001 budget request and simply eliminated earmarks added in the final scramble to get an appropriations bill passed (see Chart 2).

President Bush's budget also called for improving the E-Rate program. "The administration is seeking administrative improvements in the E-Rate to ensure that this program provides greater flexibility to schools and libraries in how they use their E-Rate discounts, while reducing the administrative burden they have faced in applying for educational technology funds," the budget document read.

Specifically, the administration called on the FCC to complete, no later than September 2002, a rulemaking to revise the E-Rate program to:

- Allocate funds for discounts on a needs-based formula
- Define eligible services to include those that promote the effective use of telecommunications, such as teacher training and software

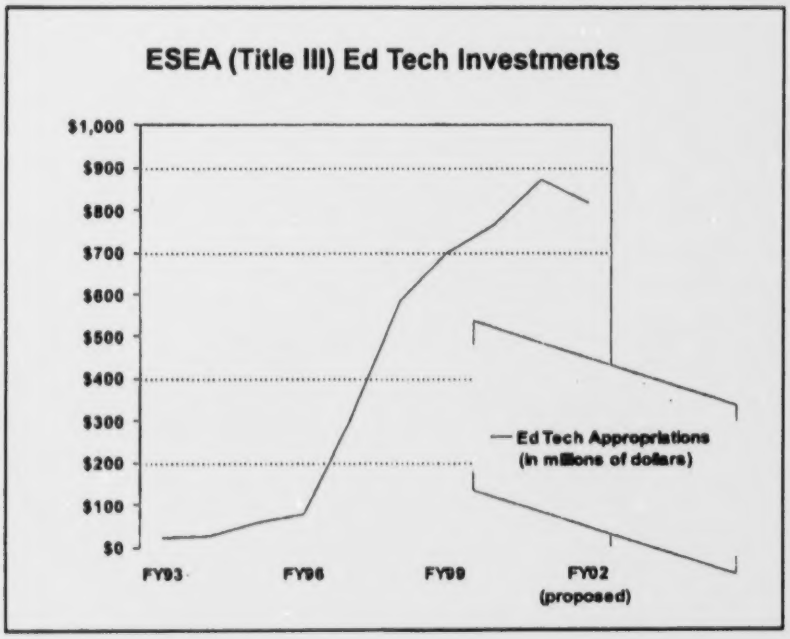

Chart 2: ESEA Ed Tech Appropriations

- Assess how to institute performance measures for the program to gauge the effectiveness of educational technology in promoting student achievement

THE E-RATE AT FOUR: FOCUS TURNS TO IMPROVEMENT

"The E-Rate program, we think, is working well," said a lobbyist for the National Education Association (NEA) in a January 2001 *eSchool News* interview. "It's an innovative way of getting resources to schools without competing for other education funding ....Tampering with the program now would be a huge mistake, and I don't think Congress will agree to do that."

Similarly, Barbara Pryor, an aide to Senator Rockefeller, reminded participants at one Benton stakeholder roundtable that changes as simple as expanding eligible services, especially beyond those related to telecommunications, could result in a new lawsuit. She told participants that in 1996 there was a great deal of debate over eligible services and, even then, lawsuits were filed questioning the legality of the FCC's decision to implement the E-Rate. She stated, "There are some people who don't like the E-Rate and would like to see it end up in court again."

But as the months passed in 2001 and it appeared the E-Rate was "safe" from being merged with appropriated programs at the Department of Education, thoughts turned from protecting to tinkering, to making needed reforms. Frustrations had been mounting for years. While praise had been near universal over the resources the E-Rate provided, for many the process of applying and complying left much to be desired. Bush's proposals sounded like a sensible alternative. Ricardo Tostado, an Illinois State Department of Education official, said at one Benton roundtable, "the E-Rate program has some badly squeaking wheels that need to be oiled." He went on

to recount that he had spoken with 300 to 400 schools in Illinois, most of which had told him they would be willing to take 30 percent less in E-Rate discounts in a block grant scenario, if they could count on the discounts as a reliable source of funding and not have to deal with all the hassles of applying and complying.

A special insert called "Rating the E-Rate," in a September 2000 edition of *Education Week*, included articles in which those interviewed expressed a similar love/hate relationship with the program. One article was fittingly titled "A Bureaucratic Hassle, But Worth It." In an introduction to the series, Andrew Trotter wrote:

But if the E-rate is now speeding many schools toward new technologies for learning, it's been a difficult journey for the nerve-racked passengers: the school officials who have had to learn the program's intricate rules, react to a seemingly inexplicable series of changes on the fly, and then wait, and wait some more, for crucial decisions to be made. Even ardent supporters bemoan the persistent problems in the program.

Many of the "bureaucratic hassles" could be traced to administrative reforms that followed the General Accounting Office's (GAO) 1998 criticism of E-Rate administration. A series of GAO reports released just before and after the election of President Bush seemed to bolster the new administration's arguments for changes. One problem was related to demand for discounts exceeding the supply. For the third and fourth program years, requests substantially exceeded the program's funding cap of $2.25 billion (see Chart 3). For complicated reasons related to E-Rate funding priorities, this especially affected the funding for internal connections and caused the FCC to consider new rules – ultimately not adopted – to make sure more applicants could receive discounts in this area.

New challenges, and perhaps another hassle, came in the form of implementing the E-Rate portion of the Children's Internet Protection Act (CIPA). CIPA places restrictions on those receiving E-Rate discounts, requiring Internet safety policies and technology solutions that block or filter certain material from being accessed through the Internet. Items to be blocked were those that "include visual depictions that are (1) obscene, (2) child pornography or with respect to use of computers with Internet access by minors, (3) harmful to minors."

The FCC did not define a "technology protection measure" but wrote that it was prohibited from extending universal service discounts to technology protection measures or other costs associated with implementing the law. The FCC issued regulations that went into effect in April 2001, requiring schools currently receiving E-Rate funds to certify that they were in the process of "complying." Year five recipients will have to be in full compliance when service starts in July 2002.

One participant at a Benton roundtable was particularly irked by this "unfunded mandate," but a congressional staff member attending the same meeting reported that Congress had held hearing after hearing on filtering, with screen after screen showing the worst sites on the Internet that children could view, and members arguing that federal funds were making this possible. Even members who did not want to mandate filtering, the participant added, felt they had to support the legislation because the issue was politically so hot that, if not addressed, could jeopardize the program.

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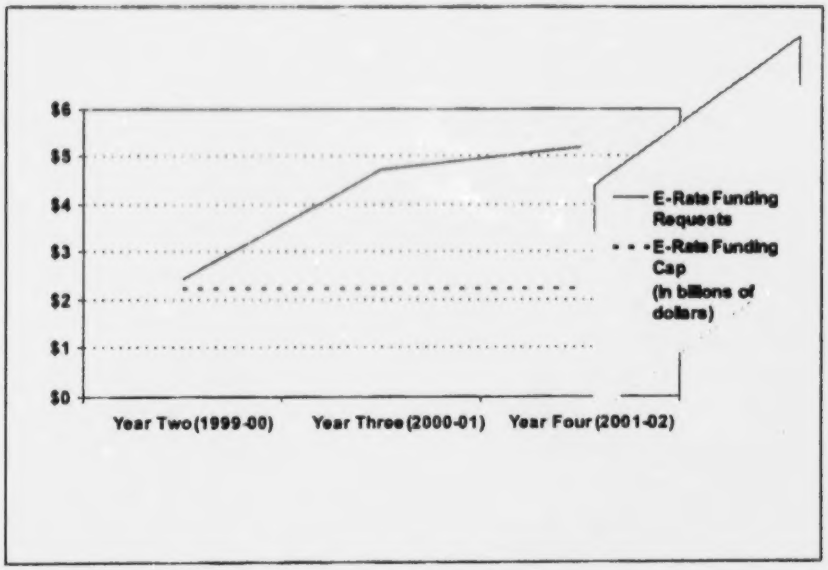

Chart 3: E-Rate Demand Exceeds Supply

The tragic events of September 11, 2001, and the subsequent bipartisan rallying around the national priority of fighting international terrorism, have taken many issues off the legislative agenda. Optimistically, this "unified" Congress could afford President Bush new leverage in pushing forward his domestic policy agenda. The impact on E-Rate policy remains to be seen.

CONCLUSION: THE FUTURE OF THE E-RATE

The SLD began the year five application period, which opened on November 5, 2001, by urging schools to file early and online. SLD officials also touted new "bells and whistles" that were meant to make the process easier. Those improvements include: a new electronic certification process, which saves the SLD from handling 30,000 signed pieces of certification paper; an electronic application which helps applicants avoid simple mistakes; and a commitment to not making any last-minute rule changes.

Drawing on input from the dialogue at Benton roundtables and conversations with key stakeholders, below are some other suggestions related to improving this important program.

- **Keep the E-Rate at the FCC and the focus the same.**

  Calls to move the E-Rate to the Department of Education as part of a block grant are misguided. Not only is the legal authority for such an action questionable but ending the program at the FCC and making it part of the annual appropriations process could jeopardize the funding. Telecommunications carriers' contributions currently support E-Rate discounts, not the federal treasury. The program's priority needs to remain connecting schools and libraries in poor or rural areas. Moving the E-Rate out of the FCC would also place the E-Rate benefits to private schools, as well as public libraries, at potential risk. A corporate representative at the Benton

Milwaukee roundtable expressed concern that the "E-Rate program will be ended and people will claim that its objectives have been achieved. There is lots of work left to do."

- **Lift the funding cap from the current level of $2.25 billion.**

  As data on the connectivity of the nation's schools indicate, the work of the E-Rate is far from over. Of course, technology is also continually changing and schools will have recurring and new costs. As Bob Nelson, director of technology for Milwaukee Public Schools, said at a Benton roundtable, "there is a propensity to declare victory too early in this work." Year three and four requests demonstrate that demand for discounts far exceeds supply. The unmet needs are especially acute in the area of internal connections. Some analysts have suggested that if the program priorities were changed, to place a greater emphasis on internal connections for example, such needs could be met. At the Benton policy roundtable in Milwaukee, one participant provided his answer to the policy dilemma: "We have to raise the caps, and we have to prioritize." Increasing the funding cap could also leverage new resources, as E-Rate discounts free up school technology funds for other critical needs such as computer and software purchases, technical support, electrical upgrades and teacher professional development.

- **Reduce the paperwork burden on applicants.**

  A Latino Issues Forum Report, released in summer 2001 and called *Connecting California's Children: Is E-Rate Enough*, focused on evaluating the impact of the E-Rate on that state's most disadvantaged schools. Researchers found that many California underserved schools that desperately need E-Rate funds do not feel they can negotiate the laborious and technical process. They simply do not have the time or staff with the grant-writing expertise necessary. The SLD has greatly simplified the process of applying for the E-Rate. The SLD should investigate in particular changes that could make it easier for smaller schools and districts to participate at higher levels.

- **Conduct outreach and assistance to schools in low-income communities.**

  Connecting California's Children reported that a surprising 43 percent of the disadvantaged schools participating in its study did not even know about the E-Rate. In trying to keep administrative costs low for the program, the FCC avoided creating a pool of resources for state leadership activities. Some larger states (such as California, Florida, Illinois and Pennsylvania) and smaller states (such as Iowa, Mississippi and North Carolina) have committed substantial resources to assisting localities to apply and comply. Schools outside of such states must often go it alone. The SLD should examine ways to improve outreach and assistance to low-income communities, including possibly creating a fund for state assistance. States should be engaged more broadly as full partners in the program.

- **Investigate ways to improve program administration and structure.**

  A participant at the Chicago Benton roundtable, representing a major education association, said, "There are serious operational problems with the E-Rate. The way the program is managed will be radically changed." Despite improvements to date, it is critical that the SLD engage in a comprehensive audit of its procedures to investigate

ways to further speed up the processing of commitments and appeals, as well as to eliminate conflicting rules and regulations. A more fundamental question is whether the SLD is structured in such a way as to be most effective in responding to local needs. Is its centralized, federal application and appeals process the most efficient way to deliver services? Would a more decentralized program, with policy driven from the federal level and administration devolved to a regional or state level, be a more appropriate structure for making grants? It is common for large federal grant programs of over $1 billion to deliver sub-state grants via a state entity, which is ostensibly more attuned to local and regional needs? Would a state-by-state allocation of E-Rate dollars, based on income, need and population, be more appropriate than the current application-driven system?

- **Reassess the appropriateness of current discount levels and priorities.**

  A critical question for the FCC is whether the current matrix of discount levels (20 to 90 percent) is most appropriate and the priorities reflect the most pressing and strategic needs. Moreover, is the student free and reduced lunch count of a school or district (currently the basis for determining discount levels) the most accurate measure of the need for resources? As the Bush administration has requested, perhaps the SLD should look at how the program can be more responsive to schools in high-cost areas. A director of educational technology for a large urban school district and participant at Benton's Chicago policy roundtable put it this way. "Maybe we should be doing fewer schools, but doing them from A to Z."

- **Expand the list of eligible products, services and vendors.**

  The FCC announced new services, such as Internet2 and wireless networks, being eligible for E-Rate discounts in year five. Despite this progress, are the current definitions of eligible hardware too limited? Are discounts for phone service still relevant given the goals of the program? Is the program keeping up with new technologies and advances? How much bandwidth is enough? Should a panel be set up by the FCC to study the issue and make recommendations that would apply to schools? Steve Kohn of Verizon, participating at the Chicago roundtable, asked, "What are the other activities you need to make the whole package workable?"

To conclude, because of the E-Rate and other federal educational technology investments, multimedia computers, high-speed networks and sophisticated new software programs are becoming commonplace in America's schools and libraries. Since the E-Rate is viewed as such a vital resource to connect disadvantaged schools to 21st-century digital opportunities, proposing to eliminate the program elicits a reaction similar to calling for cuts in the school lunch program. Former critics are now in agreement that the E-Rate is a critical investment, even as they call for "bureaucratic hassles" to be eliminated.

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CHAPTER 2: THE E-RATE TAKES HOLD, BUT SLOWLY: A VIEW FROM FOUR CITIES

BY DONNA HARRINGTON-LUEKER

Two years after receiving their first round of E-Rate funds, school officials in Chicago, Milwaukee, Detroit and Cleveland have found that building a multimillion-dollar computer network may be easier than helping schools learn to use that technology well.

That's one of the lessons to emerge from interviews with administrators, teachers and technology researchers about the current uses of technology in the districts and from visits to the districts' schools.

It also comes as the Federal Communications Commission prepares to award $2.25 billion to wire the nation's schools, bringing the total funds awarded to $8 billion. The largest share of those funds, which covers telephone service, Internet access and internal network connections, has gone to high-poverty districts.

For the four cities in this study, E-Rate funding has been a boon. In the first year of the program, Chicago, Milwaukee and Cleveland were among the top four recipients of E-Rate funds nationwide. And Detroit, which lagged behind the others in its requests for funds, asked for $68.4 million this year. That's more than the district received in the three prior rounds of funding combined.

The districts have used those E-Rate funds to build powerful telecommunications networks that rival or exceed those in more affluent suburban districts, but most have only begun to address transforming those investments into gains in teaching and learning.

The cost of updating electrical systems, the need to train massive numbers of teachers, the presence of competing reforms and contradictory district mandates, the pressure of high-stakes assessments: All affect the way technology is – and isn't – used in schools in each of these cities.

A further complication: This year, the FCC received $5.2 billion in E-Rate requests – more than twice the $2.25 billion available for distribution. Given that gap, in early May, the FCC proposed giving priority for funds for internal network connections to districts that did not receive such funding last year. That change could jeopardize the progress of all four districts in this study.

WORLD-CLASS NETWORKS

At the district level, the most obvious signs of progress are the new high-speed networks that crisscross the school systems.

Only two of Cleveland's 118 schools had Internet access at the time of EWA's first technology report. Today, after three waves of E-Rate funding totaling $74 million, the school system has built a web of high-speed connections that allows the transmission of voice, video and data to all schools.

With the exception of rooms in a few older schools recently reopened, every classroom in the district is wired for the Internet, says Frank Detardo, Cleveland's director of instructional technology.

This compares to 60 percent of classrooms in high-poverty districts nationwide in the year 2000, according to the National Center for Education Statistics, and 82 percent of classrooms in districts with the lowest levels of poverty.

(This chapter, originally published in June 2001, is reprinted with permission. It was produced for the Education Writers Association as part of a larger report, *New Networks, Old Problems: Technology in Urban Schools*. This report was a follow-up to EWA's *Barriers and Breakthroughs: Technology in Urban Schools* (1999) and charts both the progress four school systems have made in the last two years and the new challenges they face. To measure any differences in teaching and learning, the report also profiled four schools that reporters first visited in 1998-1999. Both reports may be obtained for $12 each from the Education Writers Association, 2122 P St. N.W., Suite 201, Washington, DC 20037; (202) 452-9830; ewa@ewa.org. See www.ewa.org for ordering information. The Joyce Foundation has supported both EWA and Benton's work on the E-Rate.)

Only 38 percent of classrooms in high-poverty districts were connected to the Internet in 1998, the year before receipt of the first E-Rate funds, and 57 percent were wired in more affluent districts.

Milwaukee has made similar gains. Before E-Rate, most schools in the city had dial-up Internet access, and only one-fifth of the district's 5,000 classrooms had Internet connections. "I'd be constantly saying, 'If we could go on the Internet, this is what we'd see,'" says James Furness, technology coordinator at Westside Academy I and II.

As of spring 2001, Milwaukee had connected all schools to a district-wide network of high-speed lines and fiber-optic cable. Sixty-five percent of its classrooms also had been connected, and district officials say they expect to have all classrooms online in the next 18 months.

Gains have been slower in Chicago and Detroit. Thanks to E-Rate funds, nearly half of Chicago's 600-plus schools now have T1 lines, says Chanda Davis, the district's E-Rate project manager. In 1999, only 63 schools had such access. In addition, about 40 percent of the city's classrooms are connected to the Internet, including every classroom at the high school level. Still, about a third of Chicago's schools are "flatliners" with no Internet connections at all, says Davis. These schools will be given priority in the 2001-2002 school year.

Schools that had Internet connections or school-wide networks have faced obstacles. According to Davis, some schools with networks in place before E-Rate had to redo their lines to meet new district standards. Others had to reconfigure newly installed networks because inexperienced principals had no way of judging a contractor's work early in the E-Rate program, Davis says.

But Chicago's size has been the biggest challenge. "Very few organizations in the world have more than 640 sites to deal with," says Davis.

Though smaller, Detroit also has made slower progress. As of spring 2001, the district had provided all its high schools and nearly all its middle schools with T1 lines. But less than half of the district's elementary schools have such connections, says Thomas Diggs, the district's technology director. At the same time, Diggs says it's unclear how many of the district's 8,800 classrooms are wired for the Internet.

All four districts have spent millions in local funds to upgrade electrical systems that can't support computers, printers and other peripherals. E-Rate funds cover network connections within schools, but not electrical upgrades.

With some buildings more than 100 years old, Chicago has committed $199 million to bringing the electrical systems in half its schools up to the minimum requirements specified in the E-Rate, the district's office of operations reports. Those funds have come from a $2.6 billion capital improvement program the district began in 1996. Another 200 schools are targeted for electrical upgrades in 2001-2002.

But even with the capital improvement funds, the district has had to scale back its initial plans. According to Davis, 10 rooms in each Chicago elementary school were wired for network connections in early rounds of E-Rate funding. But next year the district can only fund electrical upgrades for three rooms in each school, Davis says.

In Milwaukee, technology director Bob Nelson estimates that one-third of the schools require upgrades to support the increased demand for electricity at a total cost of $31 million.

Districts have found, too, that powerful networks can stall when classrooms lack sufficient hardware. Thanks to Ohio's SchoolNet

program, which has targeted elementary schools throughout the state, Cleveland's elementary schools have between four and five computers in most classrooms. But hardware is less plentiful in the district's middle and high schools, say teachers and technology specialists familiar with the district.

Lack of hardware has limited what teachers can do with the district's high-speed network. "It's a great leash, but there's no dog," says Shane McConnell, chair of the English department at Cleveland's East Technical High School.

ONLINE CONTENT

As the four districts put new technologies in place, other trends are emerging. For the first time, most of the districts have begun to provide online resources such as encyclopedias and information databases via district-wide networks. With more schools – and more teachers – having access to the Internet, the districts also have put local and state learning standards, sample lesson plans and advice on integrating technology into the classroom online.

In each district, too, there are efforts to spur schools to use the new technology for Web-based projects that incorporate critical thinking and high academic standards.

Chicago has invested more than $1 million in developing a suite of Web-based tools that teachers use to create projects students use online. The tools are part of the district's Technology Infusion Planning program, or TIP, an effort to train teachers to better use the Internet. The program currently reaches more than 200 Chicago teachers.

The projects, which address specific district learning standards, vary by grade and subject. A third-grade unit on the solar system asks students to select a planet and then create an online brochure that would persuade someone to become a colonist. To complete the assignment, students consult Web sites for information about the sizes of the planets, their distance from the sun, their geography and their natural resources. Once students have collected information, they post what they've learned online.

Another project on global warming asks seventh- and eighth-grade students to use Palm Pilots equipped with probes to collect air temperatures in the schoolyard. Students then enter their data into graphing software and compare their findings with real-world data on global temperature shifts.

The goal in each project is to encourage students to investigate a topic on their own, using unique resources available on the Web, and to encourage teachers to look differently at the content of lessons and the way they assess their students' work.

Bernard Bradley, a science teacher and technology coordinator at Newberry Academy, a K-8 public school on Chicago's North Side, exploits just such resources in his global-warming unit. A mentor for the TIP program, Bradley contacted a number of scientists via e-mail, asking the researchers if they would provide copies of their data for his students to use. All agreed, and that data became the core of Bradley's unit.

This year, the teacher has developed a similar project involving the effect of various environmental factors on the development of frog eggs.

In both units, he emphasizes inquiry and exploration rather than lecture. "The kids just come into the lab and go to work," the teacher says. Working in groups, students have access to 16 iMacs, all connected to a T1 line, and to four iBooks with accompanying sets of lab probes.

With new networks capable of transmitting audio and video as well as data, the districts

also are developing curricula that use video-conferencing.

Currently, six Cleveland middle schools are working with the Ohio Consortium for Conceptual Learning (OCCL), which has received $6 million from the state to develop units that target specific Ohio-learning proficiencies. Schools in Akron, Columbus and Cincinnati also are involved.

The Cleveland schools are piloting an eight-week unit on fitness and nutrition that connects students with doctors and medical researchers at teaching hospitals in the area. Next year, 41 new schools will join the statewide consortium, including 18 Cleveland high schools, says Geoff Andrews, the OCCL's director.

At the same time, schools in each district are also using their networks to deliver programs that target basic skills. Nine schools in Cleveland are working with Compass Learning, a commercial program that covers the basic math and literacy skills students need to do well on Ohio's proficiency exam. Sixth-graders in the pilot schools use the software for between 120 and 160 minutes a week. In Chicago, 14 schools are piloting Fast ForWord, a networked reading program.

Still others acknowledge that in the face of pressures to improve test scores, they've simply put technology on the back burner. "Books are just more important," says Bruce Allman, principal of Chicago's Eliza Chappell School. Eleven of Chappell's classrooms have been connected to the Internet as part of the district's ongoing capital improvement plan, but the connections were not something the pre-K-8 school had sought, says Allman. And the principal says he does not plan to increase the school's commitment to technology. Chappell already has a 36-station computer laboratory and a minimum of one computer in every classroom.

"We're still worried about reading and doing math at national norms," says Allman. Forty-nine percent of Chappell's students score at that norm in reading, and 67 percent do so in math.

TEACHER TRAINING

With considerable help from federal and private sources, the four districts are working on new strategies for providing professional development.

Cleveland is part of Alliance+, a Web-based program that helps teachers use Internet resources in the classroom. Funded by the U.S. Department of Education's Technology Literacy Challenge Fund, Alliance includes 10 weeks of workshops geared to a teacher's grade level (elementary, middle or high school), with each workshop addressing progressively more difficult applications of the Internet.

Elementary teachers begin with an introduction to the World Wide Web and to the idea of using telecommunications technology in hands-on science classes. During that introductory lesson, they also link to the Science Learning Network, an online community funded by the National Science Foundation, and to schools across the country that are involved in projects that require the sharing of data. Still other Web links take teachers to museums, including San Francisco's Exploratorium, where archived webcasts provide access to portable laser light shows and fiber-optic sculptures.

In subsequent weeks, teachers learn to set up an e-mail account on Yahoo and investigate Web sites such as the Volcano World or the Rainforest Connection. (The former is supported by NASA; the latter by the Smithsonian Institution.) Other workshops discuss how to incorporate real-time Internet resources, such as databases with updated sea-surface temperatures, into lesson plans.

In the third year of a five-year grant, Alliance has trained 820 Cleveland teachers, most of them at the elementary school level. A separate grant from the Joyce Foundation provides an additional 30 hours of training for middle-school teachers.

Federal funds have driven professional development efforts in Milwaukee. With $4 million from the Department of Education's Technology Literacy Challenge Fund, the district worked with Marquette University to develop a three-credit online graduate course on integrating technology into the curriculum. According to district officials, more than 450 teachers have completed the course.

The district also received $1.9 million from the federal government's Preparing Tomorrow's Teachers, or PT3 program, which targets students in teacher preparation programs. As part of that grant, Milwaukee is developing a video library of best classroom practices that can be delivered over the Internet and is pairing student teachers with tech-savvy teachers. The district is also working closely with faculty members in schools of education.

To help teachers learn to use technology, Milwaukee schools also have used Title I funds to hire technology specialists.

But while teacher training is critical, it's also time-intensive. "It's like a graduate course in educational measurement or disruptive behavior," says Jonathan Fairman, a high school English teacher and school technology coordinator who works with the Alliance program. "You'll do six hours of homework for every three hours of coursework."

And even that commitment might not be enough. A preliminary evaluation of the Alliance program by researchers at Kent State University showed that teachers with 30 hours of training didn't use computers more frequently than teachers with no training. Teachers who had received 60 hours of training, plus other support, reported more frequent use of computers in the classroom.

Ongoing help at the school site is essential as well, says Jim Sweet, Chicago's director of online learning. "We assumed initially that once teachers had the connection and some basic skills, they'd use the technology, but that wasn't the case," says Sweet, who came to Chicago from the National Center for Supercomputing Applications at the University of Illinois-Urbana.

"When you look at the research on innovation and effective instruction, the answer always is tools, training and follow-up," Sweet says. As part of the TIP program, a cadre of seven experienced technology-using teachers visit participating schools regularly to coach other teachers and help them refine the online lessons they've developed for the program.

Even then, Sweet acknowledges, not all teachers complete their lessons, and not all lessons make the most effective use of technology. Further, the seven mentors can only reach a small number of Chicago teachers.

MAKING TECHNOLOGY COUNT

Other challenges remain. Central offices in each of the districts continue to define the role they must play in deploying and maintaining school technology. Detroit has hired a private firm to oversee technology services the district previously provided, including computer repair and maintenance. And Chicago has developed a purchasing program that takes advantage of the district's ability to buy in bulk and offers computers to schools at reduced rates from designated vendors. But schools still report friction over the central office's need to standardize hardware and network connections and

their need for flexibility to grow their own programs. Milwaukee, too, is piloting an innovative technology advisory board comprising technology experts from across the nation.

A number of lighthouse schools, whose principals have proven themselves adept at leveraging school funds and writing grants, also continue to rocket ahead of other schools, accumulating even more resources than they had two years ago.

But such progress often demands persistence. "I'm usually a little hard to turn down," says Linda Pierzchalski, principal of Chicago's William J. Bogan Computer Technical High School, chosen this year by a national magazine as one of the nation's most-wired schools.

Bogan, which has a poverty rate of about 83 percent, received $600,000 in year two of the E-Rate program, and Pierzchalski says that the funding moved the school forward quickly with its network. (Before E-Rate, the school relied extensively on Title I funds for its technology program and had to deploy its use of technology in stages.)

Another of Pierzchalski's strategies: agreeing to become a test site for various technology programs. "My middle name is pilot," the principal says. "I simply tell people: You can try it here, but we're not paying for it."

But effective technology leadership remains elusive in many urban schools, advocates and others say. Districts and schools struggle with the technical demands of maintaining sophisticated high-speed networks, a task that is much more complex than keeping a stand-alone computer running or fixing a printer that has jammed. In most of these districts, the job of keeping the network running falls to school-level technology coordinators or technology teachers, virtually none of whom is a network specialist.

The job can be both time-consuming and frustrating. One Chicago principal notes that his technology coordinator – a teacher with a master's degree in instructional technology – has become "an electronic janitor" who spends her time keeping the servers running.

A technology coordinator at a Milwaukee middle school reports the same pressure. "It's not as much fun as it used to be," she says. "I spend a lot of time alone in a noisy, hot little room and less time with teachers."

Perhaps most tellingly, while the access to technology has increased in each of the districts, so have competing pressures. State accountability tests, an array of reform initiatives, the fear of being put on a warning list, can all push technology onto the back burner.

Combating skepticism about yet another reform is a challenge. "Teachers and administrators don't really believe that technology is the answer to their problems," says Elliot Soloway, a University of Michigan researcher who has worked in Detroit and other urban systems.

But until they do, the billion-dollar networks E-Rate has put in place are in danger of becoming the latest, and perhaps most expensive, unused instructional technology to be put in schools.

Donna Harrington-Lueker is a freelance education writer and an assistant professor of journalism at Salve Regina University in Newport, R.I.

CHAPTER 3: NEW APPROACHES TO ASSESSING STUDENTS' TECHNOLOGY-BASED WORK

BY MARGARET HONEY

After more than two decades of research on the benefits of educational technology, evidence that demonstrates the positive effects technology can have on student achievement is mounting. Specifically, studies have shown that:

- Large-scale statewide technology implementations have correlated use of technology with increases in students' performance on standardized tests.
- Software supporting the acquisition of early literacy skills – including phonemic awareness, vocabulary development, reading comprehension and spelling – can support student learning gains.
- Mathematics software, particularly programs that promote experimentation and problem solving, enable students to embrace key mathematical concepts that are otherwise difficult to grasp.
- Scientific simulations, microcomputer-based laboratories and scientific visualization tools have all been shown to result in students' increased understanding of core science concepts.

We have also learned that if technologies are to be used to support real gains in educational outcomes, then five factors must be in place and working in concert.

1. There must be leadership around technology use that is anchored in solid educational objectives. Simply placing technologies in schools does little good. Effective technology use is always targeted at specific educational objectives; whether for literacy or science learning, focus is the key to success.
2. There must be sustained and intensive professional development that takes place in the service of the core vision, not simply around technology for its own sake; moreover, this development must be a process that is embedded in the culture of schools.
3. There must be adequate technology resources in the schools, including hardware and technical support to keep things running smoothly.
4. There must be recognition that real change and lasting results take time.
5. Finally, evaluations must be conducted that enable school leaders and teachers both to determine whether they are realizing their goals and to help them adjust their practice to better meet those goals.

PLANNING FOR MEANINGFUL TECHNOLOGY INTEGRATION

The singular and dominant benefit of technology in education is its capacity to support all aspects of the learning process from the classroom to the central office. We know that technologies offer teachers and students opportunities that would otherwise be extremely difficult to realize in classroom contexts. School reformers generally recognize four areas as centrally important to improving student achievement: assessment, information access, collaboration and expression. Educational technologies have been shown to demonstrate particular promise in all four.

There is much work to be done, however, before we can realize this promise. Educators are only beginning to take advantage of the genuine potential of educational technologies. As the preceding chapters make clear, the E-Rate has enabled schools to make substantial progress in building their technical infrastructures; schools must now decide how this technology can best be used. The challenge is twofold – educators must embrace a coordinated vision of technology integration that capitalizes on technology's unique affordances, and construct a coherent approach for their schools and districts to integrate the various pieces of this vision. This means deciding what students should be learning with technology, and then applying those learning goals to

every level of the educational process – from professional development and curriculum design to classroom implementation and student assessment.

In order to improve current teaching strategy with technology, for example, ongoing professional development must be addressed. Recent national surveys indicate that the increased technology infrastructure in schools is not being matched with increasing, or even adequate, professional development for teachers. Although "teacher usage and skill level has increased in the past year ... only 8 percent of schools say that the majority of their teachers are at an advanced skill level and able to integrate technology use into the curriculum. More than 45 percent of schools report that over 50 percent of their teachers are at the intermediate skill level – able to use a variety of computer applications but not adept at integrating technology into the curriculum."

Curriculum design is another area in which educators are only beginning to connect their effort to a larger vision of technology's role. Current basic teaching strategy does not yet take advantage of the extent to which technology can add substantive learning – learning that goes beyond the rote practice of basic technology skills and drills – to classroom curriculum. Teachers generally do not view technology as a means to expand their curriculum beyond basic skills instruction, but simply as another means – a requirement, in fact – to accomplish the basic work they are already doing. They tend to see the technology components they have added to curricula as "motivational" and "skill-building," but have no clear standards or expectations for evaluating how well a student uses particular technology tools.

Relatively few teachers who regularly use technology in their curriculum make use of analytic and project-oriented software, and the few who do use interpretive software use it only infrequently. Instead, they use programs such as PowerPoint or other multimedia authoring tools to support work that is not significantly different from what they would be teaching without the technology – that is, to conduct research, write papers, make oral presentations and so on. While there is evidence that use of such programs is indeed motivational for students, we have yet to realize the potential of these tools to support the acquisition of critical 21st-century skills such as information literacy as well as the ability to communicate effectively and think critically. Multimedia software, for example, offers an expanded, more complex arena than pen and paper in which students must constantly self-edit their ideas and their presentation of the ideas. There is thus a clear need for new curriculum that accesses the unique learning opportunities that commonly used technologies can offer to students.

As they attempt to address these new challenges in technology integration, schools and districts also face the demands of growing accountability measures as well as alignment with local, state and national standards. Determining how to use technologies well and deeply to support richer learning and teaching is a tall order unto itself; having to meet the requirements of testing and standards raises the stakes even higher. These growing accountability pressures, particularly in urban environments, often relegate technology to the role of enrichment rather than viewing it as a resource that can support core teaching and learning goals. We know that continuous improvement, as well as regularly measurable information that marks improvement, are two elements of effective technology use for schools that would speak to these new challenges. Actually designing strategies to yield these elements, however, remains an elusive goal for most school systems.

Between September 2000 and June 2001, the Benton Foundation and the Center for

Children and Technology (CCT) established a collaboration with two Joyce Foundation cities – Chicago and Milwaukee – to help the districts develop locally relevant but broadly generalizable programs of work around the coordinated use of technology to support student learning. Because of its underlying importance to areas of educational improvement, we chose evaluation research to organize the ways in which create-a-vision technologies can be used to support high-quality teaching and learning.

Researchers from CCT focused on improving basic teaching strategy by developing an evaluation toolkit that would complement work already taking place in the districts, while at the same time seeking to raise the teaching and learning bar. We did this through joint work on the creation of an increasingly sophisticated framework for the use of technology. We sought to build a universal toolkit that would work across multiple content areas, and that would move teachers and their students toward an increasingly sophisticated perception on technology use. By providing teachers with a sense of beginner, novice and expert strategies, the toolkit sets forth a developmental trajectory for the process of learning to use technology well.

We also designed a framework to be used by districts in teacher professional development programs, making it possible to align the toolkit with support for teachers at varying levels or phases of integrating technology into the classroom. Finally, we wanted to develop a tool that was responsive to accountability measures; the toolkit is structured to yield information on student learning that teachers can put to immediate use, and that district administrators can use more broadly to determine whether students across the district are on track.

RECENT WORK IN TECHNOLOGY

A recent report released by the CEO Forum on School Technology and Readiness makes recommendations to ensure that the nation's investment in education technology improves student achievement and benefits education. Among these are four recommendations that speak directly to the applied research and development work we undertook in this collaboration.

- Focus education technology investment on specific educational objectives.
- Make the development of 21st-century skills a key educational goal.
- Align student assessment with educational objectives and include 21st-century skills.
- Adopt continuous improvement strategies to measure progress and adjust accordingly.

In addition to the CEO Forum report, a number of other reports have underscored the importance of developing 21st-century skills. The North Central Regional Educational Laboratory, together with Metiri Group, has developed EnGauge, a Web-based framework addressing the value of technology. This framework defines 21st-century skills as digital age literacy, inventive thinking, effective communication and high productivity, among others. Our evaluation toolkit addresses several elements of EnGauge's digital age literacy, as described below:

- **Basic Literacy:** The definition of basic literacy – reading, writing, listening and speaking – has expanded in the digital age to include media other than paper and pencil. Literate people must be able to read, write, listen and speak fluently through the use of text, images, motion video, charts, graphs and hypertext across a range of media.
- **Visual Literacy:** Students must be able to communicate through visuals; they must, in other words, be able to decipher, interpret and express ideas

through images, graphics, icons, charts, graphs and videos.

- **Information Literacy:** Literacy with information entails research with online resources, as well as an understanding of the need for critical evaluation and appropriate application of such research.

Finally, the U.S. Department of Education's recent report on e-learning argues that students must acquire the skills needed to participate in an increasingly technological society. The report states, "[a] meaningful, unified approach to providing students with the skills they will need for their futures must be more than a checklist of isolated technology skills; rather, these skills are only a first step in assuring all our children become proficient information and technology users."

In our work in Chicago and Milwaukee, we sought to map out the next step in providing such digital age skills. We have focused on five core areas of technology use: Internet research; data collection and representation (e.g., spreadsheets and graphing tools); live presentations; Web design; and illustrated reports. These areas are among the technology uses most commonly employed in classrooms. Yet while educators are increasingly teaching students *how* to use software in these areas, they are just beginning to think beyond providing "isolated skills" and toward making technology use compatible with their more fundamental goals of promoting literacy, critical thinking and sound communication skills. Our intent has been to push this thinking forward.

DEVELOPING THE TOOLKIT

Our district partners in Chicago and Milwaukee are similarly concerned with the question of how to move to the next level of technology integration. Milwaukee's director of technology, Bob Nelson, and Chicago's chef officer of learning technologies, Richard White, are eager to pursue new strategies for assessing the broad impact of technology integration on student learning in their districts. Their reasons mirror those of educational policymakers at all levels: they want to measure the impact of their technology investments but have few tools to do so.

Assessment tools such as norm-based standardized tests, the currency of educational "accountability," were not developed to assess the skills and knowledge that technology-based instruction can bring to students. Student outcomes from such assessments drive district, state and national education policy in many arenas – technology implementation is one of these. Although these tests can effectively assess a set of narrowly defined skills, they do not address the kinds of learning taking place when classroom technology is used to its maximum potential. Thus, finding new ways to identify learning goals for technology and to assess progress toward those goals have been of paramount importance to Nelson and White.

An important component of our work with the districts has been paying attention to local, state and national technology standards. National standards, such as those created by the International Society for Technology in Education (ISTE), state packages in Illinois and Wisconsin, and local Milwaukee and Chicago standards, were among the materials we referenced. These packages all include useful thinking about the technology skills students should acquire, and provide age-based benchmarks for student achievement with technology. In some cases, standards packages provide teachers with supplemental materials, such as sample lesson plans and cross-referencing with curriculum standards in other subject areas. Yet standards provide only one piece of the puzzle.

The challenge facing the standards-writers is obvious – because standards must be

applicable to all kinds of student work, and acceptable to all kinds of audiences, they can suggest a direction but cannot map out a path. On the subject of "Technology Communications Tools," for example, the ISTE standards suggest that students be able to "use a variety of media and formats to communicate information and ideas effectively to multiple audiences." In the same area of "communicating information," Wisconsin's state standards for Information and Technology Literacy provide a long list of skills that students should master "by the end of grade 8," among them the ability to "plan and deliver a presentation using media and technology appropriate to topic, audience, purpose or content."

While prescriptions like these help to establish goals for technology use, it is still up to districts and teachers to create the means of reaching those goals. In working with the Chicago and Milwaukee school districts, we sought to move these general guideposts to a concrete level – to help teachers and administrators determine where students are in their technology use, give teachers an easy and flexible strategy for defining clear learning objectives and provide concrete examples of what such objectives would look like in students' work.

The task was to distill some of our knowledge about the unique affordances of technology (and to gather new knowledge through collaboration with teachers and district personnel) into a set of professional development tools for teachers – a classroom-based evaluation toolkit for assessing the impact of technology-rich activities on skills development, student learning and media literacy. This product would build upon the standards' prescriptions for general technology use by helping teachers determine *how* and *why* specific types of technology tools are useful for promoting certain skills.

Because the toolkit starts with *evaluation*, rather than *curriculum development*, it serves multiple needs. First, it provides a means of identifying educational objectives for technology use in classrooms. Getting teachers thinking about assessment may be the clearest avenue toward helping them identify and articulate their goals for teaching with technology. The question "What would I want to see in a good piece of student work with technology?" necessarily leads to the question "What do I want my students to be learning with technology?" Second, the toolkit aids in aligning learning objectives with corresponding assessments. By emphasizing the identification of learning goals that must underlie lesson planning, focusing on appropriate assessments can drive good curriculum design. Finally, and most concretely, the toolkit offers a way to measure students' progress in technology work.

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CHAPTER 4: ASSESSMENTS OF STUDENTS' TECHNOLOGY-BASED WORK: AN OVERVIEW OF THE TOOLKIT AND CASE STUDIES

BY ANDY GERSICK, CONSTANCE KIM, JULIE THOMPSON KEANE, WENDY FRIEDMAN, KATIE CULP

The evaluation toolkit, a set of instruments that help teachers take advantage of technology affordances in their teaching, was developed in collaboration with teachers and administrators in Chicago and Milwaukee. This chapter presents the content and structure of the toolkit, and case studies that illustrate how the ideas contained therein affected technology use in our collaborators' classrooms.

THE TOOLKIT: CONTENT

The objective when creating a multimedia product is no different than with any other form of communication: A product created with technology should communicate an idea or a set of ideas. Thus, the basic questions to be addressed in the product are common to all forms of communication:

- What is the message being communicated?
- Is the message clear?
- Who is the sender?
- To whom is this message directed?
- Who is the receiver?

Although these questions may seem like an obvious starting point, they are often obscured by considerations of mere technical proficiency. Communicating well with technology demands that students know more than simply "how to use" software. They must understand how to take advantage of its unique benefits; to convey ideas via an integrated mix of sound, visuals, animation, interactivity and all the other elements that technology tools make available to them. The toolkit provides a framework with which educators can juggle, understand and evaluate the elements of teaching and assessing student work with technology, without losing sight of core learning objectives.

To organize the myriad facets of technology use into a manageable perspective, the toolkit divides technology use into four basic skill areas: digital skills, media and meaning, point of view and audience.

The first category, digital skills, covers the mechanics of technology use. The role of digital skills is like that of grammar, spelling and vocabulary; they are the basic means of production for multimedia work. A student must have the digital skills to manipulate information within a given program – cutting and pasting, formatting text, importing graphics – in order to make a coherent composition. Without knowledge of how to use software, students cannot read or compose technology products, but attaining digital skills is a means to the end of communication, not an end in itself.

Once these basic tools of communication have been acquired, the author is ready to consider her message and the most effective way to convey it. Having learned the strengths and limitations of the available media options, the author can choose a medium that most enhances her message, thereby developing the capacity to bring media and meaning together. In this category of skills, the author learns how to convey ideas in the various forms made available by technology.

Choosing media is also an important way for the author to express her point of view. All decisions about media – including decisions about text, visuals, sound effects and overall presentation format – are directed by the author's opinion and intent. Thus, in choosing the most effective media for all aspects of communicating her message, the author must be conscious of her own opinion and the differing effects of specific media on her message. The author must, in other words, recognize herself as the sender of her own personalized message and make decisions regarding media that uphold the integrity of that specific perspective. Creating a live presentation that gives equal weight to sounds, picture images and text, for example, lends a decidedly different tone to an author's message than a text- and chart-

heavy live presentation does. Depending upon how the author chooses to use and combine different media, she can emphasize, strengthen or undercut a given viewpoint.

Finally, in order to make an impact, the author must consider the audience for her message. While it is important to choose media for its compatibility with content and the author's point of view, it is equally important to choose a medium that will communicate with its receiver. Thus the author must consider which media would be most effective and compelling for the components of her message as they relate to particular audiences. For example, streaming video with fast pop music in the background would be more effective when presenting to high school students than when presenting to the parents of those students.

Within each of these skill areas, the toolkit helps teachers teach and evaluate concrete skills that students must master to be effective communicators.

THE TOOLKIT: STRUCTURE

The toolkit comprises a multi-layered portfolio of interrelated tools, including a technology affordances matrix, conceptual frameworks, checklists and sample assessments of student work for five categories of work: web design, data collection and representation, information gathering, live presentations and illustrated reports. The tools for live presentations were developed and completed during the span of our work with teachers in Chicago and Milwaukee.

Each component of the toolkit serves a distinct purpose.

- **Technology Affordances Matrix:** *entry point to the rest of the toolkit.* The matrix lists the most common forms of student work with technology, and broadly introduces the learning opportunities that each form affords students.
- **Conceptual Frameworks:** *diagnostic tools.* For each type of work (i.e., illustrated reports or Internet research), the conceptual frameworks divide each of the four skill areas (digital skill, media and meaning, point of view and audience) into basic, intermediate and advanced skills, and provide essential descriptions of each skill level. Teachers can use the frameworks as roadmaps to determine where their students are in terms of their technology use, and what kinds of skills they must learn to become more sophisticated users.
- **Checklists:** *The "meat" of the toolkit.* While the conceptual frameworks provide general descriptions of skill areas, the checklists give teachers concrete descriptions of specific skills for students to learn. For example, where the frameworks say broadly that an intermediate-level live presentation would be one in which "each medium (text, images, sound) brings something distinct to the meaning of the presentation," the checklists direct teachers to look at every component of a live presentation, such as spoken narrative, text, illustrations and sound effects. The checklist is a flexible tool; teachers can pull from the checklists when planning lessons or when designing rubrics to assess student work.
- **Sample Assessments of Student Work:** *A user's guide to applying the tools.* These sample assessments walk teachers through a step-by-step process of using the frameworks and checklists to assess a sample piece of student work.

Working together, the four pieces of the toolkit can guide a teacher through the process of planning, implementing and evaluating technology-based lessons. She can decide what medium to work with using the technology affordances matrix; locate her students' level of sophistication on the conceptual framework; devise a lesson plan

referencing the checklists and pull from the checklists to create a grading rubric; and use the sample assessment as a guide to evaluating her students' work.

CASE STUDIES: COLLABORATING WITH TEACHERS IN CHICAGO AND MILWAUKEE

The toolkit was developed through a collaborative process of work with teachers and administrators in Chicago and Milwaukee. Center for Children and Technology (CCT) researchers began by conducting classroom observations to assess partner teachers' current levels of technology use. CCT and partner teachers then collaborated throughout the school year to develop technology-rich classroom projects that would incorporate the concepts we planned to build into the evaluation toolkit. CCT and partner teachers held frequent discussions about the format and content of the toolkit, and about how the core ideas were playing out in classes. Researchers also conducted secondary classroom visits to help teachers implement technology projects and to observe teachers' evolving classroom practice as they grappled with new technologies and new goals for technology learning.

Both Chicago and Milwaukee are large, complex districts, where administrators must consider and manage concerns ranging from standardized testing pressures to budget shortages. Both have pursued significant amounts of E-Rate and other technology funding. Both are in the thick of an evolving process of technology implementation, charged with simultaneously developing plans to build and maintain infrastructure, creating technology-related professional development, tracking the impact on students and justifying all of these undertakings to both local constituents and state policymakers.

MILWAUKEE: The Milwaukee Public School (MPS) system is the thirteenth-largest school system in the country, serving over 105,000 students in 160 schools. Milwaukee's High Standards reform includes eighth-grade completion standards, benchmark content standards for each grade, district performance assessments and school improvement plans.

CCT's work in Milwaukee involved two collaborators: the Wisconsin Conservatory for Lifelong Learning (WCLL) and the John Audubon Middle School (Audubon). WCLL has an enrollment of 980 students in pre-K through twelfth grades. Of those, 71 percent receive free or reduced lunch, and 15 percent have exceptional education needs. According to WCLL, "Technology is the kernel from which much of the teaching and learning that occurs at WCLL emanates." Every WCLL classroom is equipped with Power Macintosh computers. The school also boasts interactive video (distance learning) and school-wide broadcasting capabilities, including a technology-enriched computer suite, and an Information Resource Center with numerous fiber drops and computers. Currently, there are two primary sets of standards that shape their curriculum development process – the MPS K-12 Teaching and Learning Goals.

The Audubon school is a board-approved specialty school in the area of communications. According to the school's mission statement, "Communications Technology is a key element of Audubon's goals, its standards, assessments and its curriculum, which are driven by the District's High Standards." Audubon has three computer labs, with various software programs that support desktop publishing, computer-aided design, digital photography, graphic arts, multimedia and other forms of technology-based activities. Audubon is additionally equipped with two video (distance learning) rooms, a math and science technology resource lab and a video production lab.

CHICAGO: With approximately 500,000 students enrolled in 596 schools, Chicago Public Schools (CPS) is the fourth-largest school district in the nation. With 86 percent of its students coming from "low-income families," CPS has been one of the largest recipients of E-Rate funds, totaling over $75 million. To ensure that teachers and students benefit from these large investments in the technology infrastructure, the district's Department of Learning Technologies is providing professional development opportunities that support the alignment of technology standards to the CPS framework and to Illinois Learning Standards.

The Center for Children and Technology collaborated with two schools in Chicago, the North Kenwood Oakland Charter School (NKO) and the Nathanael Greene Elementary School. Each school was selected with the help of district administrators. The Greene school has an enrollment of 770 students. Of those, over 95 percent are Hispanic and over 80 percent of the student body receives free or reduced lunch. The Greene school had a pre-existing relationship with CCT: last year, the school collaborated with CCT on a Joyce Foundation-funded project to develop a Technology Training Center for one of the district's regional divisions. Greene teachers act as mentors to visiting teachers and demonstrate technology integration in the classroom. The Training Center provides teachers the opportunity to see technology integration in real classrooms with real teachers and students. The Greene school has two networked PC and Macintosh G3 labs. Each classroom is equipped with one networked teacher station and four Oracle computers.

The North Kenwood Oakland School (NKO) has an affiliation with the University of Chicago's Center for School Improvement. NKO is a K-8 school with 306 students enrolled. Over 95 percent of the student body is African-American, and of those, 62 percent receive free or reduced lunch. The school has developed a technology plan that will fully integrate technology with its current project-based curriculum. Each classroom is equipped with four or five networked PCs, and the school has one networked PC lab.

TEACHERS' CHALLENGES AND POINTS OF VIEW

Like teachers nationally, our partners at Audubon, Greene, the North Kenwood Oakland School and the Wisconsin Conservatory for Lifelong Learning share a belief in technology's potential to bring new learning opportunities to the classroom. They note that when using technology their students are more "motivated" and they have a general sense that technology is a "powerful" learning tool. As is so often the case, however, going beyond this feeling to identifying and articulating where that power lies and how it is best tapped was a struggle for all the teachers in this project. Without the time or training to think in detail about teaching with technology, few had used the resources available to them, and many tempered their faith in technology's potential with a healthy skepticism about its practical value.

"Why should I spend time teaching my kids to do something on the computer that they could do just as well the old way – with posterboard," one teacher asked. It is a concern for most teachers, and it illuminates the current state of technology use in schools. The challenge facing teachers is not how to teach content with technology – they know how to do this just as they know how to teach content through traditional media – but how to identify and develop the unique skills associated with new media and technologies.

What attracted teachers to this collaboration was the prospect of developing tools that would help them and other teachers

make technology meaningful in their classrooms. Specifically, what could technology bring to the learning experience that was unique to technology use?

The question for our collaborators was not whether students should be using these technology tools, but how educators can make technology use compatible with their deeper goals of promoting literacy, critical thinking and sound communication skills. To begin to move in this direction, teachers need help guiding their students past the bells and whistles of technology tools – the novelty that can motivate students in the short term but does not contribute to real sustained learning over time. The justification for technology in the classroom lies not in simply teaching students to use technology, but in teaching them to use it well. With that step, classroom technology could blossom from an expensive distraction to a vital part of the learning experience.

COLLABORATION IN THE CLASSROOMS

In repeated planning discussions, teachers and CCT researchers chose a number of classroom projects that were consistent with teachers' content goals for the school year and would also provide opportunities to work with technology tools. These projects spanned a wide range of work, including science experiments and class presentations, oral reports on history, online research and web page creation. In the course of these projects, students used Internet search engines, word-processing software, drawing and oral presentation programs, spreadsheet software and web design programs – the same tools that research indicates are the ones most commonly employed in classrooms.

For some of our collaborators, fixed curricula and testing pressures allowed time for only one major project incorporating new concepts about technology. These teachers went through a process of talking to researchers about their own emerging goals for technology use, working to incorporate new ideas from the evaluation toolkit into their project work with students, and conferring afterwards with researchers about the changes they saw in student work, and about the challenges they faced during these first attempts to enhance their teaching with technology. Their experience is best exemplified by the work of "Tabitha James," a sixth-grade science teacher.

Ms. James had spent a summer working with students in a technology-rich environment, and was motivated by the work her students had done there and by her own experiences teaching with these new tools. All of the students she worked with over that summer had in the end achieved proficiency, according to the MPS standards, and Ms. James strongly believed that the use of technology within this program was largely responsible for their level of success. She did not, however, have an explicit sense of how technology had supported her summer students, or how that experience could be replicated.

In Ms. James's school, teachers and researchers decided that our work would center around the sixth grade's annual science fair project. The semester-long project engaged students with the scientific method by requiring them to design and carry out a controlled experiment. In the past, students wrote reports on their experiments and presented them to the class using a posterboard presentation design. This year, technology would be integrated in three areas of the work:

- **Research:** Students would use Internet research to identify an area for investigation and to develop a hypothesis for testing.
- **Data Collection and Analysis:** Working with their math teacher, students would use spreadsheet software to track and chart their data.

- **Presentation**: Students would develop and deliver multimedia presentations of their research and findings to classmates, teachers and parents.

The content of this project remained the same as in years past – students carried out typical science fair experiments on the relative growth rate of bean plants. They chose which variables to manipulate: sun vs. shade, water vs. coffee, etc.

At the same time, the means of organizing and presenting information had changed. Students would use the Microsoft Excel program to chart their data, and MS PowerPoint to create their oral presentations. Working with CCT researchers, Ms. James sought to take advantage of the new opportunities that technology tools might offer her students. She placed additional emphasis on the visual component of presentations, making it clear to her class that their talk should complement rather than reiterate what was on their slides, that they were not allowed merely to read from the screen, and that visual aids should illustrate different kinds of information from the oral component. Further, she encouraged students to consider the flexibility that technology tools could afford them. Students were told in advance to be prepared to answer questions about their projects from both the teacher and the other students, and that as a class they should be listening to one another and should ask questions about areas that needed clarification or make suggestions for further research or alternative explanations. When students organized and presented their work, a number of important benefits were quickly apparent.

The first was that students had new choices to make about how their data should be organized. Where the time-intensive nature of plotting numbers by hand had meant that Ms. James gave her students limited choices in the past, the software her students currently employed offered almost limitless options. Students were now faced with the need to make qualitative decisions about what formats would best convey the meaning of their data. For the first time, students had the opportunity to learn by looking at "wrong" representations – to place the same sets of numbers into bar graphs, pie charts and line plots, and to learn how each of these formats affected the meaning of their information. Having this task automated meant that they could examine a number of permutations quickly and come to understand the manner in which different data are best represented.

The table below represents the data collected by "Sheena," a student in Ms. James's class who tested the relative growth rates of bean plants watered with different liquids.

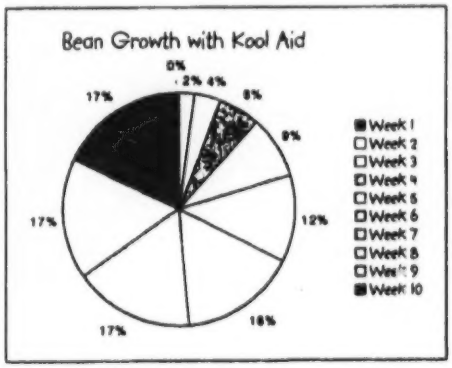
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
Kool Aid	0 in.	0.8 in.	1.4 in.	2.2 in.	3.2 in.	4.6 in.	6 in.	6.2 in.	6.4 in.	6.6 in.
Water	0 in.	0.5 in.	1.5 in.	2.1 in.	3.3 in.	4.8 in.	6 in.	6.4 in.	6.5 in.	6.7 in.

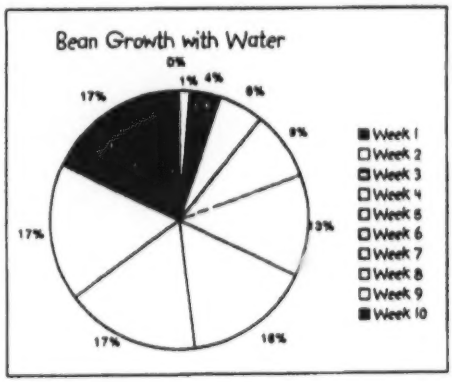
After she had entered her data into a spreadsheet, Sheena found herself faced with a couple of questions:

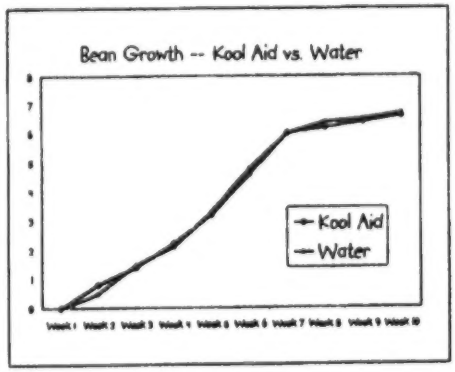
First, what kind of graph would best represent these numbers? In years past, Ms. James had never needed to teach her students how to distinguish the relative merits of different modes of data representation. She simply taught them how to make one kind of graph, and all students used the same one. However, the flexibility afforded by the spreadsheet program meant that students like Sheena could cycle through numerous graphing options: in this case, Sheena's goal was to represent the comparative growth rates of plants she had watered with Kool-Aid and with water, and she was considering both pie charts and line graphs.

A discussion naturally followed from this choice in which Ms. James and her students talked about the different qualities of each type of graph. The pie chart would be perfect if you wanted to know when the plants had grown the most – it enabled the viewer to see which weeks had featured significant plant growth and which had not. But it did not make it easy to compare the growth rates of the two plants. The line graph, on the other hand, was less precise in its representation of growth in each individual week, but made it easy to make a simple visual comparison between the two liquids' relative growth rates. All of the students learned from Sheena's dilemma about the ways in which different graphs can communicate different information, even when the data represented are the same.

A second question arose when Sheena was building a slideshow in PowerPoint to accompany her oral presentation. Which should come first – the table or the line graph? This apparently simple question actually required a critical consideration of the different types of representation. Was the graph a visual aid for explaining the table, or was the table a mere appendix, with the graph being the key representation?







Questions such as these – how to present data to an audience so that the most significant points will be clear – are important considerations for real scientists. But they had never come up in Ms. James's class

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before. Only with the introduction of technology tools did students have the power to make real choices about how to represent their data.

An additional benefit of adding technology to the science fair project became evident during students' class presentations. Presenting data visually in a flexible, technology-based format meant that the presenters, the class and their teacher could all work with the data together during the presentation – something that would not have been possible if the data had been presented in a more traditional medium, such as a poster. Students therefore had the opportunity to become aware of misconceptions and misinterpretations embedded in their work, and to rethink with their classmates how they could correct those missteps.

While these new opportunities were readily apparent in Ms. James's classroom, the end of this project found her still in the middle of her confrontation with new ideas and dilemmas around technology. On the one hand, Ms. James's teaching with technology was opening up new possibilities in her classroom: the flexibility afforded by spreadsheets and visual presentation tools gave her students new options and new things to think about in organizing and presenting their data; the need to think critically about visual choices in constructing their slideshows broadened students' concepts of what it meant to communicate effectively; and the oral presentations themselves provided an opportunity to engage students in one another's work and thus help them learn how to anticipate their audience's needs and communicate their points effectively.

At the same time, teaching these new ideas was not easy for Ms. James. She herself struggled at times to figure out the best way to present a student's data, or to advise her students on decisions about the style or layout of their presentations. Further, Ms. James often limited her interaction with student presenters to questions about content. She asked questions almost exclusively for the purpose of seeing if the student understood his own experiment – yet to assess her students' grasp of new communications skills, she knew she needed to ask questions about how they had chosen to convey that understanding to others.

Though Ms. James had not yet fully integrated new ideas about technology into her teaching, the groundwork was laid in this first project. Introducing technology into an established lesson had added new dimensions to her students' learning. Now that Ms. James is more comfortable using these technology tools with her students and understands the particular opportunities that technology brings to the classroom, she feels more prepared to tackle these new challenges in the upcoming school year.

EVOLVING TECHNOLOGY USE: MULTIPLE PROJECTS IN CHICAGO

Teachers who had the chance to use CCT's tools with multiple student projects began developing a new relationship to technology use. Their students' work with technology reflected the growing palette of ideas being addressed in their classrooms.

"Susan Moran" had her fifth-grade class work on three oral-report lessons during the collaboration with CCT researchers; the first on the Revolutionary War, the second on explorers and the third on America's physical expansion in the 19th century. In each unit, students showed a marked improvement in both their technical mastery and critical use of multimedia presentation tools. This steady improvement evinced not only the students' progress, but also the development of Ms. Moran's thinking about how best to teach with these tools.

The following two pages lay out some of the changes that occurred as Ms. Moran and her students progressively enhanced their approach to multimedia, folding in new skills and concepts in a yearlong process of working with CCT researchers.

The slide below is from a presentation students created using Microsoft PowerPoint. In its strengths and weaknesses, it is by no means atypical of the class's early work with the program.

The slide illustrates a number of common themes we encountered in students' early work with technology tools of all kinds, before they had had the chance to think about how different media are qualitatively different from paper and pencil.

Most obvious is the pure *technical* inadequacy – the fact that the text runs off the page.

Conceptual issues are also abundant, but harder to qualify:

- The student author does not yet understand the requirements of this medium: that material be divided across slides in a way that will correspond to his oral narration.
- He has not taken his audience into account when formatting his text (the text's size and length make it inaccessible).
- The student does not use visual aids to carry part of his information. He is presenting an essay on a slide.

Finally, this student author has not learned to make *aesthetic* or *stylistic* choices. He has not exploited the expressive qualities that multimedia can add to a report. He does not employ color, sound or layout to emphasize any one piece of information over another.

Robert Falcon Scott

On March 29,1929 three dying men lay on the frozen Antarctic continent-three men who had made their way to the South Pole. On their way, they had been in a terrible blizzard with in 11 miles(18 kilometers). (Robert was born on June 6, 1868 and died on March 29, 1929). Robert died when his boat sank in the middle of the Arctic Ocean with three of his crew members.

Scott led two expeditions to the south pole and died on the second trip. His expedition was the second to reach the south pole. Scott led his first British Antarctic expedition on the HMS Discovery. They sailed along the northern Ross Island to Mount Terror. Scott found some area and named it King Edward VI land. Scott went in a hot air balloon to the Antarctica. Scott and two members tried cross the Ross Ice Shelf on a sled on November 1902 throw January 1903. Tried to cross a lake of Vitamin C and mad them ill and were forced to return. Most of the crew returned to England but Scott and a few others stayed to explorer until September 1904. On his return Scott was promoted as captain and became popular with the public and wrote "The Voyage of Discovery."

In 1910 Scott went on his second expedition on a ship named Terra Nova. He was

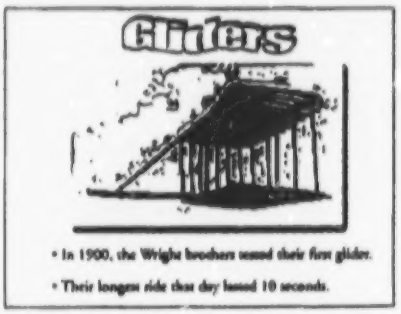
This first piece of work represents the very baseline of student work with technology, in which the student has yet to tackle the new elements that the technology brings to the process of composing.

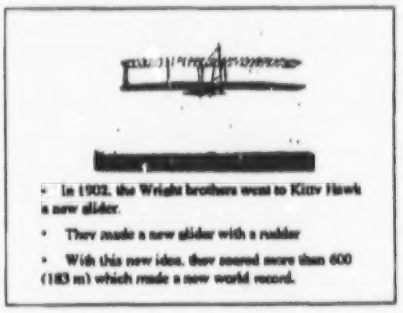
The next three slides also come from Ms. Moran's classroom, later in the school year. By this time, the students were far more technically proficient than they had been. Their slides were competently composed with little use of distracting or superfluous animation or sounds. More important, students' multimedia presentations were becoming meaningful narrative compositions. Students were becoming "writers" in this medium. To a far greater degree, students in this class used both text and pictures to contribute to the meaning of their work. Far fewer students were seduced by flashy but distracting graphics, sounds or animation, and more students were using different aspects of the medium to add meaning to their presentations.

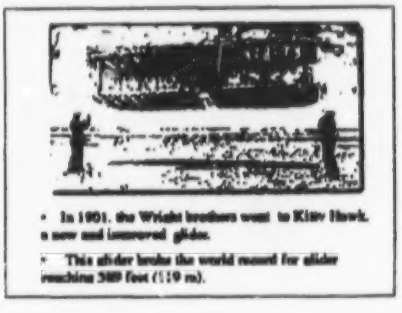
The slides come from a student report on the Wright brothers. They demonstrate the creator's new mastery of a number of important skills outlined in the Conceptual Framework for Live Presentations:

- **Narrative building** – The presentation takes advantage of the slideshow format to present a clear, well-sequenced storyline.
- **Layout** – Each slide is laid out to maximize the impact of key visual and text elements.
- **Making meaning with visual material** – The photos presented are not merely pictures; they add to the audience's understanding of how the Wright brothers' invention evolved over time by illustrating those new developments to match their descriptions in the text.
- **Creation of aesthetic tone** – The authors employed a consistent design scheme for the entire presentation, with all of the elements, from the font to the background color (Originally sky blue, depicted here in black and white), contributing to an overall effect in which each element builds on the last and all elements contribute or correspond to the themes of the report.

The report does not merely "look professional." It communicates clearly.




• In 1902, the Wright brothers went to Kitty Hawk a new glider.
• They made a new glider with a rudder
• With this new idea, they soared more than 600 (183 m) which made a new world record.


• In 1903, the Wright brothers went to Kitty Hawk, a new and improved glider.
• This glider broke the world record for glider reaching 389 feet (119 m).

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CLASSROOM IMPACT

Assessing the effects of technology use in the classrooms of our teacher-collaborators raises two questions: First, how did teachers' work with the ideas from CCT's evaluation toolkit impact students' use of technology? Second, how did this approach to technology affect students' work relative to previous work created *without* technology?

The first question is easier to answer. Over the course of their projects, students' use of software, such as spreadsheet programs and multimedia presentation tools, changed in several observable ways. Students' preoccupation with the frivolous and distracting aspects of technology – cosmetic but content-inappropriate features such as flashy colors and backgrounds, time-consuming but empty animations and sound effects, and superfluous graphics – dropped considerably. At the same time, students increasingly used technology to enhance the effectiveness of their work. They experimented with multiple arrangements of data until they found representations that conveyed information clearly. They created increasingly polished and professional slideshows, employing fonts and layouts that enhanced the clarity and force of their narratives, eschewing distracting sounds and animation and using visual aids that added to the meaning of their presentations. Furthermore, the levels of student growth increased in relation to the time their teachers were able to devote to work with technology. The more teachers were able to take advantage of their work with researchers as a professional development experience, the more new ideas they passed on to their students.

The second question – How did improved technology use compare to pre-technology work? – is harder to answer. Using spreadsheets and presentation programs such as PowerPoint did not "solve" the issues that teachers had traditionally faced when working with student projects: students still sometimes botched their research, made errors of judgment or reasoning, mumbled their speeches, missed key content areas or failed to construct coherent narratives. Technology was not a panacea for all students' mistakes, nor did it raise the quality of all students' work to an equal degree.

What technology did do was allow students to draw on a different and more varied skill set when analyzing data and creating presentations. While not every student took advantage of the opportunities provided by spreadsheets or multimedia tools, many did create "deeper," more sophisticated projects with greater ease than would have been practical without using technology. Students enhanced their science reports with clearer and more flexible representations of data. They deepened their presentations with sets of maps, charts and contrasting photographs, which would have been unwieldy or unavailable had they not used technology tools to gather and present their visual content. They engaged, at times, in livelier discussions with their classmates because they could refer to these more accessible visual aids. They made sophisticated aesthetic choices that heightened the impact of their points of view.

Even still, these changes seem small when looked at in the grand scheme of a school year – an increase in students' literate use of one or two computer programs. But if these developments represent just one part of these students' growing literacy, they also represent only a small fraction of our partner teachers' total teaching and preparation time. In other words, converting technology into a productive class activity took up a relatively small portion of teachers' time, once they were provided with tools to aid in lesson planning and assessment.

Further, all of these teachers were still in the early stages of rethinking their technology

use. Working with CCT researchers – considering technology use in the light of concepts like media and meaning, point of view and audience, as outlined in the conceptual frameworks – pushed teachers to build new layers into their technology-based lesson planning. The technology tools that had been undistinguished stand-ins for paper and pen began to take on new value as teachers and students engaged the unique qualities of multimedia. At the end of a year, this evolution was by no means completed, but it was a process that, once begun, became self-perpetuating. Each advance in their students' technology use raised new questions for teachers, about how and why students could use technology more effectively. The completed evaluation toolkit will provide greater assistance to teachers seeking to answer these questions. With similar professional development tools to address every technology-related aspect of their curriculum, teachers could turn their students' time on the computer into a vastly more effective learning experience.

Perhaps most important, the teachers who collaborated with CCT made the leap from seeing technology as merely another means for accomplishing the work they were already doing, to seeing technology as a medium for teaching 21st-century skills, and thus creating new learning opportunities in the classroom. This is the goal of the evaluation toolkit. It is this fundamental shift in perspective that educators must encourage at the school, district and state levels if we are to capitalize on the gains that E-Rate funding has enabled. As long as teachers view technology as an "add-on," these multimedia tools will be little more than complicated means for doing the same things, and they will be obsolete long before they justify their purchase price. If, however, schools and districts can infuse their technology plans and professional development with a vision of the unique learning that technology can foster, the E-Rate will be money well spent.

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CHAPTER 5:
ENHANCING STATE AND LOCAL POLICYMAKING ABOUT EDUCATIONAL TECHNOLOGIES

BY CHRIS DEDE

Discussions about distributing E-Rate funds through a formula-driven block grant reflect a changing policy climate in which the focus has shifted from direct federal grantmaking to increased power and responsibility for agencies at the state and local level. Recently, resources historically awarded and administered directly by federal government agencies have instead increasingly "passed through" federal channels to state and local governments, where decision-makers have greater latitude in determining how to spend these funds.

Both the U.S. House and Senate versions of the current Elementary and Secondary Education Act (ESEA) reauthorization propose moving a substantial amount of educational technology monies from specialized federal programs into block grants. Whether this shift is good or bad, it apparently is an idea whose time has come.

Student assessment is another illustration of an education policy area in which states are assuming a greater role. State high-stakes tests, linked to state curriculum standards, are now the single largest influence on what is taught in many classrooms. Frequently, individual pupils, teachers, schools and districts are rewarded or punished based on the results of these tests. This approach to student assessment may soon assume even greater prominence, since plans for ESEA reauthorization include federally mandated, state-selected annual testing in math and reading from grades three through eight. While many experts have serious concerns about using summative tests as the sole measure of educational outcomes, both politicians and the public are endorsing this strategy for education reform.

In these circumstances, state and local decision-makers face increased responsibility and accountability to go along with greater resources and powers. Yet many state governors, legislators and agency personnel, as well as school superintendents, school board members and district officials have brief spans of time in office, a limited background in technology and education and numerous other demands on their attention. Providing a "State Policy Framework for Assessing Educational Technology Implementation" may enhance these decision-makers' capacity to improve learning and schooling through information technology.

A STATE POLICY FRAMEWORK FOR ASSESSING EDUCATIONAL TECHNOLOGY IMPLEMENTATION

The State Policy Framework for Assessing Educational Technology Implementation (see Appendix 1) delineates a menu of ways that state policies can enhance educational technology usage to improve student learning and standards-based educational reform. The framework also presents a process for categorizing and charting the evolution of state policy for learning technologies in the overall context of strategic planning to improve education. This tool is intended primarily as a means of self-assessment for state department of education staff and other education decision-makers.

The seven categories in the framework span the spectrum of potential state policy actions and provide a common template for comparative policy discussions among policy setters.

Categories

A. State Technology Standards and Assessments for Students
B. State Technology Standards, Assessments, Professional Development and Assistance for Teachers and Teacher Educators
C. Statewide Subsidized Electronic Network Linking Districts and Other Stakeholders for Information Exchange, Collaboration and Distance Education

D. Statewide Program Providing Data or Administrative Systems to Districts (e.g., fiscal databases, student assessment results)
E. State Guidelines for Technology-Related Facilities Design, Equipment, Software, Connectivity and Infrastructure; Statewide Consortium Purchasing Programs (Discounts for Large-Scale Orders) and Funding Support for Technology Acquisition
F. State-Sponsored Research and Evaluation of Educational Technology Initiatives; Development of Educational Technology Devices, Applications and Approaches; Dissemination and Adaptation of Educational Technology
G. State Strategic Plan for Educational Improvement, Including Technology; State Funding for Educational Technology Plans and Initiatives

Each category has a set of essential questions that highlight the issues involved in policies of this type. These questions are followed by indicators that depict an evolutionary path for the progression of state policy, while allowing for variation among states depending on individual circumstances and political philosophy. For example, one of the essential questions in the *State Technology Standards and Assessments for Students* category is "Are technology tools and services used as a vehicle for ongoing improvement of student learning and assessment?" Three indicators related to this question are:

- State provides online resources for model curriculum units and lesson plans linking state content standards and student assessments.
- State assessment strategies exemplify effective use of technology for assessment.
- State provides incentives to develop virtual learning environments for students who have difficulty obtaining access to classroom settings.

The more indicators a state and its localities satisfy in their implementation of educational technologies, the more complete and aligned its policies are in ensuring effective usage to improve student learning and standards-based reform.

GENESIS OF THE FRAMEWORK

The concept of developing a State Policy Framework originated as part of a National Science Foundation-funded project conducted by the Council of Chief State School Officers (CCSSO). This project centered on experts in various aspects of educational technology preparing papers on how advances in computers and telecommunications were creating new opportunities for state policies that could enhance student learning and the effectiveness of schools. These commissioned papers were presented and discussed at the CCSSO Technology Conference in February 2000.

Out of this dialogue came an initiative to prepare an educational technology policy framework for states. The initial draft was refined in discussion with policymakers from several states who were advanced in their thinking about educational technology and then presented at the 2001 CCSSO Technology Conference. After that event, the NEIR*TEC federal technology center sponsored an ongoing web-based discussion about the State Policy Framework (see www.neirtec.org/statepolicy).

In May and June 2001, the Benton Foundation hosted two meetings. In attendance were federal, state and local education decision-makers, corporate and foundation leaders and other key stakeholders who provided in the course of their discussions feedback on the policy framework. This dialogue was valuable in both broaden-

ing and deepening the framework; it also served as a catalyst for the creation of the concept maps that follow later in this chapter.

The State Policy Framework complements initiatives by the CEO Forum, the International Society for Technology in Education and other groups that have developed visions for the usage of computers and telecommunications in education, as well as assessment rubrics for charting progress toward those visions. The framework, by focusing on *how* to achieve a vision rather than on *what* the components of the vision might include, provides a repertoire of interrelated mechanisms that states and other stakeholders can use to actualize desired outcomes in educational computers and telecommunications. Formulations of process, such as this framework, are a vital means for accomplishing the substantive recommendations that a variety of groups have made for educational technology usage.

STATES' CURRENT USAGE OF POTENTIAL EDUCATIONAL POLICY MECHANISMS

Relatively little is known about states' current implementation of the policy mechanisms presented in the framework. Most surveys of educational technology in the various states have focused on the technologies and teacher training now in place rather than examining their state policies that caused the implementation. This is an important area for further research.

Some fragmentary information about state educational technology policies, however, is available. The May 2001 issue of *T.H.E. Journal* published a "Technology Report Card" for the states. This report indicates that one-third of the 31 states reporting require students to take a course about technology before graduation, while a number of other states that do not require a full technology course do have technology standards and performance objectives in their state curriculum standards. That is, 90 percent of the states responding either require or recommend the integration of technology into the curriculum. Although nine of these states have "approved lists" of hardware and software, none of the states responding regulates or prescribes the purchase of computer hardware, and only two of these states regulate or prescribe the purchase of administrative software. Twenty-two states reported that they have some sort of system for gathering information on technology usage and technology accountability.

A May 2001 special issue of *Education Week*, entitled "Technology Counts: The New Divides," contained state technology implementation data from a survey conducted from October 1999 to March 2000. Thirty-four percent of all public schools surveyed responded, and the data were aggregated to allow cross-state comparisons:

- Twenty-six states require teachers to have technology training before being licensed to teach; but only Idaho, Michigan and North Carolina require a technology test for prospective teachers.
- Of the 20 states that require schools or districts to set aside time for professional development for teachers, just Arkansas, Florida, Tennessee and West Virginia have such a requirement for technology-related professional development.
- While 38 states have recertification requirements for teachers, only Connecticut, Georgia, North Carolina and Virginia include technology as a part of those requirements.
- Thirty-five states have student standards for technology, but only Florida, North Carolina, Pennsylvania and Virginia test students on those standards.
- Fifteen states offer teachers professional or financial incentives to use technology; 11 states offer such incentives to administrators.

Detailed data on states' usage of the numerous policy mechanisms delineated in the framework, but not included in these surveys, is needed.

INTERRELATIONSHIPS AMONG EDUCATION POLICIES

The categories in the State Policy Framework are richly interrelated, as policies that affect any aspect of the educational system have consequences and affect other parts of the system. As an example, the concept map in Figure 1 illustrates the interrelationships among aspects of the educational system related to student assessment.

In addition to improving student learning outcomes, interventions that enhance diagnostic assessments of students impact models of effective curriculum, teacher pedagogy, statewide data collection and analysis, and parent and community involvement. Shifts in statewide data collection and analysis impact state research and evaluation, which influences the state plan for educational improvement, which in turn shapes teacher professional development and teacher preparation.

The case studies in this report describe the process of implementing a new means of diagnostic assessment in select Milwaukee and Chicago public schools. The outcomes of these case studies illustrate many of the interactions in Figure 1. For example, even in the early stages of implementation, teachers rethought their approach to instruction and curriculum, and students gained new insights into their learning. Research studies documented why this innovative, technology-based educational strategy was

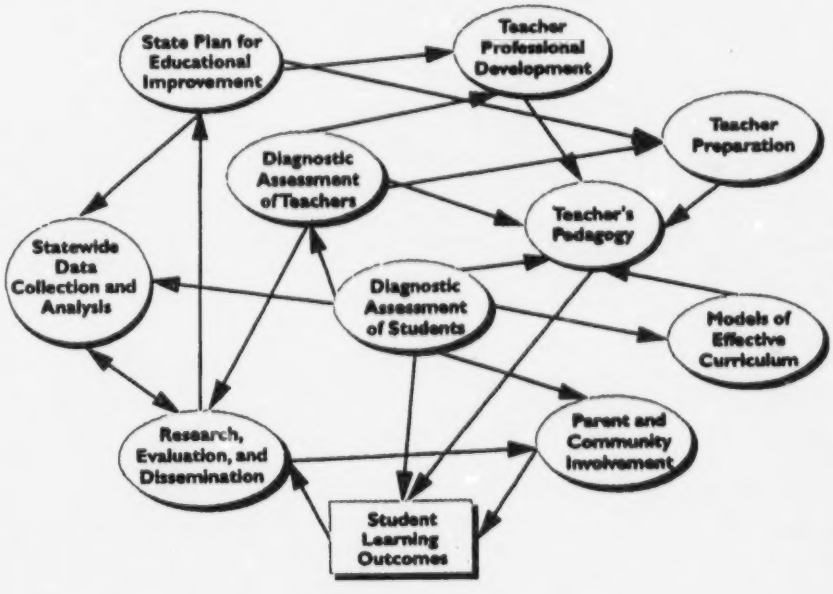

Figure 1: Concept Map of Improvements In Student Assessment

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powerful, suggesting implications for teacher preparation and professional development. As new approaches to diagnostic assessment and their associated innovations mature, broader impacts with implications for local communities and for state policies are likely.

Thus, the potential benefit of diagnostic student assessments is much greater than simply their direct, immediate effect on aiding student learning through better feedback to teachers and students. Concept map analyses that trace the potential effects of an innovation such as diagnostic student assessment both clarify the overall implications of this advance for educational improvement and highlight other policy areas affected by this intervention. This aids decision-makers in understanding how to alter the overall configuration of state policies in response to an advance in any single area of education.

Tracing the potential impact on state policies of federal E-Rate funding also illustrates this principle of rich interdependence among interventions in the educational system. Support from the federal government reduces the amount of funding a state must spend on financial support for districts' purchasing of technology and telecommunications products. Both these added funds and the additional equipment and telecommunications services provided by the E-Rate have beneficial second-order impacts on other types of state education policies, as illustrated by the concept map in Figure 2.

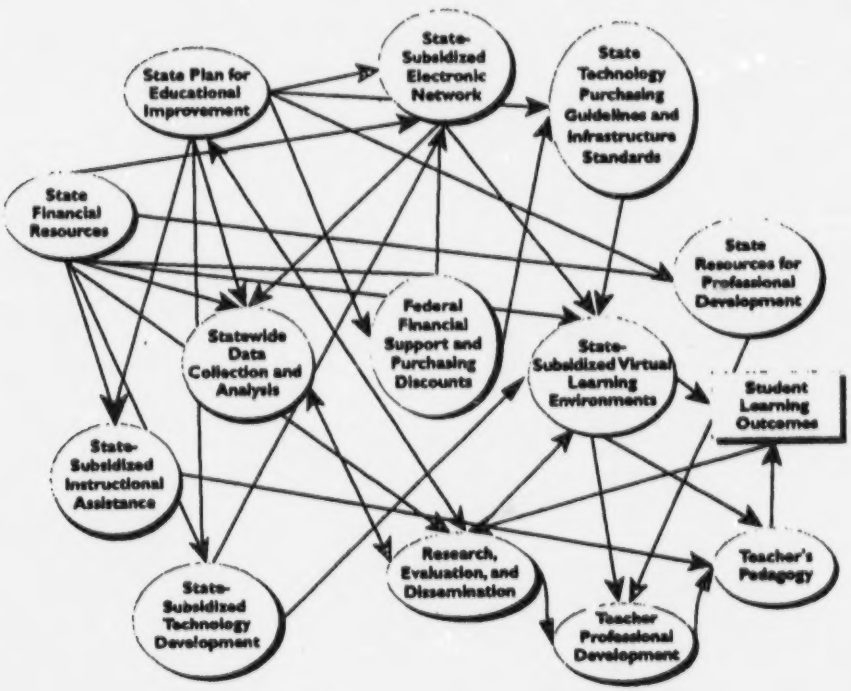
State Plan for Educational Improvement
State-Subsidized Electronic Network
State Technology Purchasing Guidelines and Infrastructure Standards
State Financial Resources
State Resources for Professional Development
Federal Financial Support and Purchasing Discounts
Statewide Data Collection and Analysis
State-Subsidized Virtual Learning Environments
Student Learning Outcomes
State-Subsidized Instructional Assistance
Research, Evaluation, and Dissemination
Teacher's Pedagogy
State-Subsidized Technology Development
Teacher Professional Development

Figure 2: Concept Map of Financial Support and Purchasing Discounts

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As an illustration, Chapter Two of this report (reflecting interviews with teachers, principals and administrators) documents many of these second-order effects of E-Rate expenditures on technology infrastructure. These include both how the curriculum and the media used to deliver and assess learning have been altered and how opportunities for professional development have increased. Distant experts and archives complement teachers' knowledge. With a reliable, multi-year source of funding, strategic visions guide annual investments in computers and telecommunications. As these innovations permeate statewide from exemplary schools, this evolution will provide a foundation for new types of state policies like those in Figure 2.

Increased federal financial support and purchasing discounts for telecommunications can free up state funding allocated for that purpose to be used instead to enhance other areas of educational technology policy, such as instructional assistance, technology development, data collection and analysis, a state electronic network, virtual learning environments, professional development, and research, development and evaluation. These in turn can have positive effects on teaching and learning and other initiatives in the state plan for educational improvement.

Furthermore, the state can implement an electronic network with higher bandwidth and more advanced services, because of the sophisticated technology purchasing and infrastructure development districts can accomplish using federal E-Rate funding. Overall, the E-Rate can have positive policy effects well beyond its direct impact on telecommunications equipment and services in districts. Of course, this assumes that states use the funds the E-Rate frees in other ways that enhance the implementation of educational technology, rather than reallocating those resources into the general fund, as some states unfortunately are doing.

As these concept map analyses demonstrate, the framework's lists of categories, essential questions and indicators are effective in highlighting the types of policies available to states, but they don't convey the extent to which effective educational innovation requires the simultaneous implementation of mutually reinforcing, co-aligned policies across various categories.

A concept map that conveyed the complete and complex web of interrelationships that underlie a systems model of educational improvement, such as that presupposed by the framework, would be too complicated to serve as a useful analytic tool. However, an electronic version of the framework could incorporate into each indicator its interrelationships with policy options in other categories, allowing decision-makers to implement mutually reinforcing, co-aligned policies with maximum leverage for educational improvement.

Beyond incorporating the interrelationships described above, future stages in the evolution of the framework could involve:

- Including a glossary
- Implementing a question-based format for using the assessment (such as the Computer Systems Policy Project Readiness Guide at www.cspp.org/projects/readiness)
- Including policy examples from various states that provide specific illustrations, benchmarks and quantitative levels for indicators
- Validating the overall model through application to several states exemplifying a wide range of policy settings.

Other ideas for further development are welcome. An online forum for providing feedback about this framework is available at ww.neirtec.org/statepolicy.

CONCLUSION

The types of improvements specified above would enhance the effectiveness and utility of the State Policy Framework for Assessing Educational Technology Implementation. Even when this framework is fully developed, however, the individual variability among states is so large that decision-makers should not use this type of analytic strategy to identify a "best" model for technology policies. Feedback by state policymakers on the framework indicated that, while successful practices in other states often offered insights for adapting those policies, each state has its own unique politics, culture and local implementation challenges. This is why the framework is best used as a menu of possible policy actions, a map of interrelationships among policies and a means of self-assessment, rather than a comparative measure of states' conformance to a single constellation of policy choices.

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APPENDIX A: STATE POLICY FRAMEWORK FOR ASSESSING EDUCATIONAL TECHNOLOGY IMPLEMENTATION

State Policy Framework ©2001 by Chris Dede. Permission granted to copy without revision for educational use. To request permission for other uses, contact Chris Dede (Chris_Dede@Harvard.edu).

This framework describes ways that state policy can enhance educational technology usage to improve student learning and standards-based educational reform. The framework presents a process for categorizing and charting the evolution of state policy for learning technologies in the overall context of strategic planning to improve education. Its content draws on ideas in the policy papers commissioned for the February 2001 CCSSO State Educational Technology Conference, as well as on items in the American Institutes for Research Online Survey of State Technology Coordinators (www.air.org/essi/look/ isetview .html). Its format is based on assessments using a framework of indicators and essential questions, such as EnGauge (www.ncrel.org/engauge/) and the New England Association of Schools and Colleges Standards for High School Accreditation and Restructuring (www.lab.brown.edu/neasc/).

This framework is intended primarily as a means of self-assessment for state department of education staff. The categories provide a menu for potential state policy actions, as well as a common template for comparative policy discussions among education staffs. The indicators depict an evolutionary path for the progression of state policy, while allowing for variation among states depending on individual circumstances and political philosophy. The essential questions are a way for staff to communicate the rationale for policies to decision-makers such as governors and legislators.

To refine the framework, I am interested in receiving feedback on the following questions:

- What types of state policies for educational technology should be added to, or deleted from, these categories?
- Should any categories of policies be combined or disaggregated?
- How can the essential questions and the indicators of policy evolution for each category be improved?
- How are these categories of state policies interrelated?

Beyond incorporating the results of feedback, future stages in the evolution of this assessment tool may include:

- developing a visual model of educational innovation through technology, to complement the category format by showing interrelationships among policy activities
- including policy examples from various states that provide specific illustrations, benchmarks and quantitative levels for indicators
- including a glossary
- implementing a question-based format for using the assessment (such as the Computer Systems Policy Project Readiness Guide online at www.cspp.org/projects/readiness)
- validating the overall model through application to several states exemplifying a wide range of policy settings.

I welcome other ideas for further development.

Please let me know your reactions by joining the online dialogue about this framework at www.neirtec.org/statepolicy. Thanks!

VI. CATEGORIES OF STATE POLICIES FOR EDUCATIONAL TECHNOLOGY IMPLEMENTATION

A. **State Technology Standards and Assessments for Students**
B. **State Technology Standards, Assessments, Professional Development and Assistance for Teachers, Teacher Educators, and Administrators**
C. **Statewide Subsidized Electronic Network Linking Districts and Other Stakeholders for Information Exchange, Collaboration and Distance Education**
D. **Statewide Program Providing Data or Administrative Systems to Districts (e.g., fiscal databases, student assessment results)**
E. **State Guidelines for Technology-Related Facilities Design, Equipment, Software, Connectivity and Infrastructure; Statewide Consortium Purchasing Programs (Discounts for Large-Scale Orders) and Funding Support for Technology Acquisition**
F. **State-Sponsored Research and Evaluation of Educational Technology Initiatives; Development of Educational Technology Devices, Applications and Approaches; Dissemination and Adaptation of Educational Technology**
G. **State Strategic Plan for Educational Improvement, Including Technology; State Funding for Educational Technology Plans and Initiatives**

A. STATE TECHNOLOGY STANDARDS AND ASSESSMENTS FOR STUDENTS

Essential Questions

How does the state ensure quality in student learning, assessment and usage of technology?

- Does the state have a well-articulated set of policies and procedures that support the ongoing improvement of student learning?
- Do these policies and procedures specifically address the integrated usage of technology to enhance teaching, learning and assessment?
- Do these policies and procedures specifically address the diverse needs of the varied population of learners for whom schools are responsible?
- Are technology tools and services used as a vehicle for ongoing improvement of student learning and assessment?

Indicators

- State technology standards and assessments created for students at all grade levels.
- State technology standards for students are validated against national models such as International Society for Technology in Education standards.
- State technology standards for students include provisions for learners with special needs and varied linguistic, cultural, ethnic and socioeconomic backgrounds, including educational resources designed for universal usability.
- State provides incentives to develop virtual high schools and similar distance learning opportunities for students who have difficulty obtaining access to classroom settings.
- State technology standards for students are integrated into state content standards for students.
- State assessments of students' progress in meeting technology standards are integrated into and aligned with state assessments of students' progress in meeting content standards.
- State assessment strategies exemplify effective use of technology for assessment.

B. STATE TECHNOLOGY STANDARDS, ASSESSMENTS, PROFESSIONAL DEVELOPMENT AND ASSISTANCE FOR TEACHERS, TEACHER EDUCATORS AND ADMINISTRATORS

Essential Questions

How does the state ensure quality in teaching and administration?

- Does the state have a well-articulated set of policies and procedures that support the ongoing improvement of teaching and administration?
- Do these policies and procedures specifically address the integrated usage of technology to enhance teaching, learning and assessment, as well as to improve school management?
- Are technology tools and services used as a vehicle for ongoing improvement of teaching and administration, as well as for assessing compliance with these standards?
- Is state financial assistance provided to enable districts to meet these standards and use technology as a means of professional development?
- Does the state fund programs and organizations whose mission is to aid educators in achieving these standards?

Indicators

- State technology standards are set for all teachers and teacher educators.
- State technology standards for teachers and teacher educators center on technology integration.
- State technology standards for teachers and teacher educators are validated against national models such as ISTE standards for teachers and NCATE standards for teacher educators.
- State technology standards for teachers are integrated into other state teacher standards and aligned with student technology and content standards.
- State assessments of teachers' and teacher educators' progress in technology standards, based on integration into content areas, exemplify effective use of technology for assessment.
- State assistance is provided for developing district and teacher education program professional development plans in technology usage, in students' safe and acceptable use of technology, and in copyright and intellectual property issues.
- State financial incentives for professional development include administrators and state-level leaders.
- State financial incentives for professional development emphasize technology integration and student assessment.
- State financial incentives for professional development emphasize districts with unusual challenges, such as urban and rural settings and impoverished communities.
- State support for professional development includes aid for exemplary technology usage in professional development (e.g., virtual communities-of-practice and distant mentoring), and increased time for educators' planning.
- State supports technical training programs for school and district technology coordinators, teacher education program faculty, and instructors of content courses for teachers.

- State-provided regional technology centers aid all educators (including instructors of content courses for teachers), including providing quality reviews and adoption guidelines for digital resources.

C. STATEWIDE SUBSIDIZED ELECTRONIC NETWORK LINKING DISTRICTS AND OTHER STAKEHOLDERS FOR INFORMATION EXCHANGE, COLLABORATION AND DISTANCE EDUCATION

Essential Questions

Has the state developed a capacity for information exchange, resource sharing and collaborative action among multiple stakeholders at all levels?

- Do educators have access to high-bandwidth networking services?
- Do state subsidies for these services give priority to groups who otherwise would likely not be connected?
- Are policies and programs in place that support collaborative partnerships among districts, higher education, state government agencies and for-profit and nonprofit organizations?

Indicators

- All districts and schools are connected via a state-subsidized electronic network.
- State financial incentives for participating in the network emphasize districts with unusual challenges, such as urban and rural settings and impoverished communities.
- High-speed connections to the state network are installed at all schools
- State creates incentives for districts to receive discounts in implementing and maintaining the network.
- State provides financial incentives and logistical support for districts collaborating electronically with other districts, higher education, industry, and other social service providers.

D. STATEWIDE PROGRAM PROVIDING DATA OR ADMINISTRATIVE SYSTEMS TO DISTRICTS (e.g., fiscal databases, student assessment results)

Essential Questions

Does the state provide districts with aggregated, synthesized information on which to base educational policies and decisions?

- Does the state encourage districts to collect data in ways that facilitate aggregation and analysis?
- Does the state provide financial incentives for districts to participate in data-based decision making?
- Does the state analyze comparative data from schools to assess alternative educational interventions and disseminate the results to districts?

Indicators

- State provides incentives for districts using common administrative systems.
- State financial incentives for participating in data collection and analysis emphasize districts with unusual challenges, such as urban and rural settings and impoverished communities.
- Educational statistics are collected from all districts are aggregated and analyzed by the state.
- Data mining of statistical records is conducted by the state, extensively disseminated, and used for policy decisions.

E. STATE GUIDELINES FOR TECHNOLOGY-RELATED FACILITIES DESIGN, EQUIPMENT, SOFTWARE, CONNECTIVITY AND INFRASTRUCTURE; STATEWIDE CONSORTIUM PURCHASING PROGRAMS (DISCOUNTS FOR LARGE-SCALE ORDERS) AND FUNDING SUPPORT FOR TECHNOLOGY ACQUISITION

Essential Questions

Does the state aid districts in designing and purchasing their technology infrastructure?

- Does the state provide guidelines for purchasing equipment, software and connectivity and for designing or renovating facilities?
- Does the state negotiate volume-purchasing discounts from suppliers and vendors?
- Does the state provide financing for technology infrastructure, and does this support give priority to districts that face economic challenges?

Indicators

- State technology purchasing guidelines stress evolutionary, strategic approaches in developing infrastructures for new and existing facilities and for installations of equipment, software and connectivity.
- State technology infrastructure standards are integrated with districts' and teacher education programs' educational plans.
- Based on advances in technology, technology purchasing guidelines and infrastructure standards for facilities, equipment, software and connectivity are regularly updated.
- State has established a program for hardware, software and online services purchasing, with discounts for large-scale orders.
- Extensive state financial support is offered for hardware, software and online services purchasing.
- State financial incentives for technology and infrastructure development emphasize districts with unusual challenges, such as urban and rural settings and impoverished communities.

F. STATE-SPONSORED RESEARCH AND EVALUATION OF EDUCATIONAL TECHNOLOGY INITIATIVES; DEVELOPMENT OF EDUCATIONAL TECHNOLOGY DEVICES, APPLICATIONS AND APPROACHES; DISSEMINATION AND ADAPTATION OF EDUCATIONAL TECHNOLOGY

Essential Questions

How does the state provide support for the effective usage and evolution of educational technology resources?

- Does the state assess the effectiveness of its technology investments through conducting research and evaluation studies?
- Does the state sponsor the development of technologies customized to its needs?
- Does the state provide means by which districts can adapt innovations successful elsewhere?

Indicators

- Systematic state-sponsored research is based on analyses from statewide database; policy decisions are based on research syntheses.
- State provides incentives for districts to apply as designated testbeds for innovation, evaluation.
- State systematically evaluates technology initiatives, including collection of evaluations from other sources and usage of analyses from statewide database; outcomes inform policy decisions.
- State provides vendors with guidelines on desired devices, applications and assistive technologies.
- State offers vendors incentives for developing desired devices and applications as well as for involving local teachers in adapting standards-based software.
- State sponsors educational technology development, including distance education, as well as participation in consortia for this purpose.
- State systematically disseminates information on transfer and adaptation of innovations via technology service centers and state electronic network.
- State research, development and dissemination initiatives emphasize technological innovations that could improve equal educational opportunity.

G. STATE STRATEGIC PLAN FOR EDUCATIONAL IMPROVEMENT, INCLUDING TECHNOLOGY; STATE FUNDING FOR EDUCATIONAL TECHNOLOGY PLANS AND INITIATIVES

Essential Questions

Does the state make strategic investments in improving education through technology?

- Does the state have a strategic process for educational improvement to which the state technology plan is aligned?
- Does the state provide systematic long-term funding for achieving the objectives of its technology plan?
- Does the state leverage its educational technology investments with related funding from other sources?

Indicators

- State plan for educational technology incorporates insights and lessons learned from other states, federal efforts.
- State plan for educational technology is aligned with overall state strategic plan for educational improvement.
- State plan for educational technology emphasizes innovations that could improve equal educational opportunity.
- State systematically funds capital investments in educational technology infrastructure, including depreciation.
- State systematically supports long-term funding for hardware, applications, connectivity and professional development.
- State systematically supports long-term funding for adequate staffing in technology usage (based on guidelines such as those in the North Carolina Technology Plan at www.tps.dpi.state.nc.us/tech plan2000/techplan2000.htm1#Personnel).
- State provides assistance in applying for funded educational technology initiatives.
- State provides matching funds to foster participation in federal and philanthropic educational technology initiatives.
- State policy complements and supplements federal and philanthropic funding, research, and equity initiatives.
- State financial incentives and assistance emphasize districts with unusual challenges, such as urban and rural settings and impoverished communities

APPENDIX B: EDUCATIONAL TECHNOLOGY EVALUATION RESOURCES

1. PUBLICATION/TOOL:
Professional Development: Learning from the Best

ORGANIZATION:
NCREL

URL:
www.ncrel.org/pd/toolkit.htm

PURPOSE:
Help districts and schools plan and evaluate professional development.

KEY FEATURES:
Guidelines for implementing a successful, large-scale professional development (PD) initiative, with elements culled from winners of the National Awards for Model Professional Development.

STRUCTURE:
Three steps (designing professional development; implementing professional development; evaluating and improving professional development), each with accompanying suggestions and tools.

IMPLEMENTATION:
A manual is available for downloading or use online and lays out the steps to successful PD, with accompanying forms, checklists, etc. to help teachers and administrators organize the PD process.

2. PUBLICATION/TOOL:
enGauge

ORGANIZATION:
NCREL and the Metiri Group

URL:
www.ncrel.org/engauge

PURPOSE:
Help districts and schools plan and evaluate the system-wide use of educational technology.

KEY FEATURES:
Guidelines for implementing and evaluating large-scale technology integration. Covers pedagogy, professional development, and evaluation and assessment. Provides further resources.

STRUCTURE:
Outline of six essential conditions of effective use of technology: vision, effective practice, equity, leadership, access and educator proficiency. Offers suggestions and examples for implementing the essential conditions and assessment tools for evaluating initiatives against the enGauge model.

IMPLEMENTATION:
Project leaders register with the enGauge site and can then access online surveys that help them assess the progress of their tech integration initiatives.

3. PUBLICATION/TOOL:
Profiler

ORGANIZATION:
High Plains RTEC

URL:
http://profiler.scrtec.org/

PURPOSE:
Improve teacher/student collaboration to improve technology skills.

KEY FEATURES:
Assessment tools around a variety of technology skill areas, from facility with individual programs to the understanding of proper pedagogy. The program helps groups of users identify individuals who can be mentors around a given skill, thus encouraging collaboration within the group.

STRUCTURE:
Thirty-four online surveys designed by both corporate and educational organizations track individual progress around a variety of technology and technology-teaching skills. Individuals use surveys and Profiler informs them of other people in their group (class, school, district) who are expert in the given skill area, encouraging group members to teach one another. The site also offers tutorials in all of the surveyed skills.

IMPLEMENTATION:
Surveys are available online or in print. Implementing the collaboration element is up to the user group.

4. PUBLICATION/TOOL:
Technology Project Evaluation Instrument

ORGANIZATION:
SEIR*TEC and the North Carolina Department of Public Instruction

URL:
www.seirtec.org/eval.html

PURPOSE:
Created to assess Technology Literacy Challenge Grant projects but also applicable to assessing district technology programs.

KEY FEATURES:
Tool to help school system leaders: (a) reflect on the progress of an ongoing technology integration project, (b) think about what needs to be done in order to meet project goals, and (c) consider strategies for maximizing project impact. The instrument also offers tools for collecting and reporting comparable information across the projects.

STRUCTURE:
A survey for project managers to assess the progress of their ed tech integration projects.

IMPLEMENTATION:
The tool is available online as an aid to reflection and self-evaluation.

5. PUBLICATION/TOOL:
STAR Chart

ORGANIZATION:
The CEO Forum on Education and Technology

URL:
www.ceoforum.org/starchart.cfm

PURPOSE:
Provides benchmarks against which K-12 schools and colleges can assess and track their progress in technology integration.

KEY FEATURES:
Identifies and defines four school profiles ranging from the early tech school (a school with little or no technology) to the target tech school (a school is a model for the integration and innovative use of education technology).

STRUCTURE:
Questionnaire addresses three critical questions: a.) Is your school using technology effectively to ensure the best possible teaching and learning? b.) What is your school's current education technology profile? C.) On what areas should your school focus to improve its level of technology integration? The Chart is intended to help project managers set benchmarks, apply for grants, determine funding priorities, and create individualized assessment tools.

IMPLEMENTATION:
Users complete an online, multiple-choice questionnaire that provides instant feedback on how their school is doing in its technology integration process.

6. PUBLICATION/TOOL:
Learning with Technology Profile Tool

ORGANIZATION:
NCRTEC

URL:
www.ncrtec.org/capacity/profile/profwww.htm

PURPOSE:
Helps teachers rethink both their general teaching practices and their approach to technology use.

KEY FEATURE:

Survey tool to help educators compare their current instructional practices with a set of indicators for engaged learning and high-performance technology usage.

STRUCTURE:

Teachers fill out a multiple-choice survey to create a profile of their teaching practices, which is then graphed against a low-to-high scale in two major areas, engaged learning and high-performance technology.

IMPLEMENTATION:

This is a tool for individuals to complete online.

7. PUBLICATION/TOOL:

Professional Competency Continuum and the PCC Assessment Tool

ORGANIZATION:

The Milken Family Foundation

URL:

www.mff.org/publications/publications.taf?page=158

PURPOSE:

The assessment tool helps educators assess their or their school's status along a "professional competency continuum" (PCC). The PCC represents research- and classroom-tested approaches to developing the skills in teachers and administrators necessary for effective integration of technology in learning.

KEY FEATURES:

Survey covers five key areas: administrative competency; classroom and instructional management; core technology skills; curriculum, learning and assessment; and professional practice.

STRUCTURE:

Users can complete either a general or a detailed assessment. The tool scores each of 4 to 6 specific indicator areas within the five major areas. Taking the detailed assessment provides the user with access to customized advice and other Milken Foundation PD resources.

IMPLEMENTATION:

Survey is aimed at individual teachers or administrators.

BENTON
FOUNDATION

8 February 2002

Dear Colleague:

We are pleased to share our latest publication, *Great Expectations: Leveraging America's Investment in Educational Technology* and the companion volume, *The Evaluation Toolkit: A Work in Progress.*

This work is phase two of a collaboration between the Center for Children and Technology at the Education Development Center and the Benton Foundation. The effort examined the impact of the E-Rate and educational technology in schools and developed new tools to assist teachers, administrators and policymakers. The findings and recommendations in our report were compiled by experts in the field of educational technology and highlight the need for expanded teacher training and new curriculum design.

In February 2000, the Benton Foundation and the Center for Children and Technology released one of the first studies of the federal program begun in 1997, *The E-Rate in America: A Tale of Four Cities.* The Joyce Foundation, a Chicago-based philanthropy committed to school reform and educational technology, generously supported both projects. Recently, the Joyce Foundation announced support for a third phase of the E-Rate series to investigate the important issue of sustainability in the educational technology arena.

The Benton Foundation, now in its 21st year, continues its focus on communications in the public interest with a strong commitment to accelerating digital opportunity for all people. Additional information about our program and vision for the future is available online at www.benton.org.

Thank you for your interest in our work.

Sincerely,

Andrea L. Taylor

Enclosures (2)

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